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# A Mathematical DICTIONARY: OR, A *dig. 1823.* *Compendious Explication* OF ALL MATHEMATICAL TERMS, Abridg'd from Monsieur Ozanam, and Others.

With a Translation of his Preface; and an  
Addition of several easie and useful Abstracts; as  
plain Trigonometry, Mechanicks, the first Properties  
of the three Conick Sections, &c.

To which is added, an *Appendix*, containing  
the Quantities of all Sorts of Weights and Measures;  
the Explanation of the Characters used in *Algebra*.

Also the Definition and Use of the Principal  
Mathematical Instruments, and the Instruments them-  
selves curiously Engraven on Copper.

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Written by J. Ralphson, F. R. S.

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L O N D O N,

Printed for J. Nicholson at the King's-Arms  
in Little-Britain, and T. Leigh and D. Midwinter at the  
Rose and Crown in St. Paul's Chnrch-yard, 1702.

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# A MAGNETIC DICTIONARY

ALDO

## Compulsory Education

THE ALTO

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BRITAN  
NICVM

69d

Whelan, P. A. *Archaeol. E.R.S.*

## МОДОЛ

112 of pages and the same number  
of lines, and a printed book is hard  
as that you are to buy it, and the  
books are read **THE**

# PREFACE TO THE READER.

**T**HE Usefulness of the Mathematics in General, and of some Parts of them in Particular, in the common Affairs of Humane Life, has render'd some competent Knowledge of them very necessary to a great Part of Mankind, and very convenient to all the Rest that are any way conversant beyond the Limits of their own particular Callings.

To be perfectly ignorant in all the Terms of them is only tolerable in those, who think their Tongues of as little Use to them, as generally their Understandings are. Those

## The P R E F A C E

whom Necessity has obliged to get their Bread by Manual Industry, where some Degree of Art is required to go along with it, and who have had some Insight into these Studies, have very often found Advantages from them sufficient to reward the Pains they were at in acquiring them. And whatever may have been imputed (how justly I'm not now to determine) to some other Studies, under the Notion of Insignificancy and Loss of Time; yet these, I believe, never caused Repentance in any, except it was for their Remissness in the Prosecution of them. And though Plato's Censure, that those who did not understand the 117 Prop. of the 10th Element, ought not to be rank'd among Rational Creatures, was unreasonable and unjust: Yet to give a Man the Character of Universal Learning that is destitute of a competent Knowledge in the Mathematicks, is no less so.

For a small Assistance to those who are willing at an easie Rate to be acquainted with the Terms, the Booksellers design'd the following Dictionary, which is a brief Epitome of Monsieur Ozanam, with the Translation of his Introduction, to which I have added some short Abstracts I found by me, the extraordinary Easiness whereof, together with

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to the READER.

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with their Sufficiency to create at least some Idea of what they carry in their Frontispieces, may make them not unfit Companions for a Dictionary, the chief Design whereof is only to interpret words, and raise the first Notions of their meaning in the Reader's understanding, on which Account I have not added any thing, even in the Appendix, that might look like either tedious or difficult, or require any thing more than common Sense join'd with indifferent Attention, to understand them.

The first of these Abstracts is only a sort of Memorandum: For plain Trigonometry, as I found it in an old Anonymous Manuscript, without either Demonstration, or any Variation of working the same Case different ways, and only design'd for the Memory of those that don't care to trouble their Heads with any more than needs must, to carry on the dull Repetitions of those Practices they may perhaps get their Livelihoods by.

The second exhibits the first Essential Properties of the 3 Sections of the Cone, demonstrated as by an old Friend, to whom I owed some of the first Rudiments of Geometry.

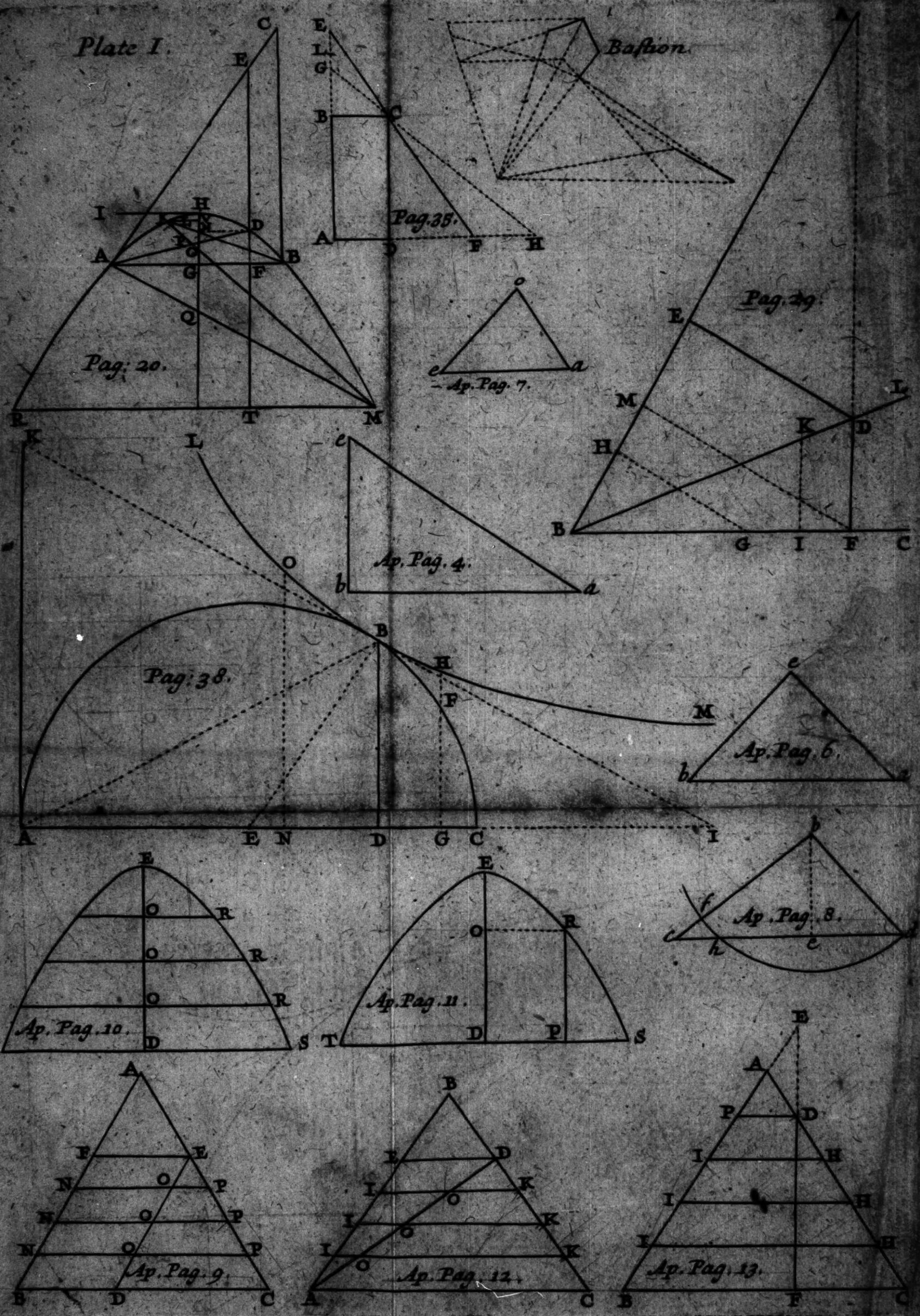
The third explains the five Principles of Mechanicks, as they may be seen something more at large in Pardie's *Elemens de Mechaniques*,

## The PREFACE, &c.

chaniques, from one Universal Principle, or original Proportion, together with some additional Application of them to some of the most common Cases in humane Affairs.

The next is only an Addition of some Curves out of Ozanam, which could not be so conveniently inserted in the Body of the Dictionary.

TO



## The Introduction.

**A**ltho' *Mathematics* (the *Mathematicks*) according to its Etymology, signifies only *Discipline*; yet it merits the Name of *Science* better than any other, because its Principles are self-evident, and independent on any sensible Experience, and its Propositions demonstrated beyond all possible Doubt or Opposition. Youth were anciently instructed herein before Philosophy, on which Account Aristotle called it the *Science of Children*. This was taught them not only to raise and excite their Genius, but also as a fit preparative to the Study of Nature; and it was upon this Account that the Divine Plato inscrib'd on his School, Οὐδεὶς ἀγνώστης εἰσέσθαι, that none wholly ignorant of Geometry should be admitted there.

By *Science* is understood a Knowledge acquired by, or founded on clear and self evident Principles, whence it follows that the *Mathematicks* may truly be stiled such.

*Mathematicks* therefore is a *Science* which teaches or contemplates whatever is capable of Measure or Number as such. When it relates to Number, it is called *Aritmetick*; but when to Measure, as *Length, Breadth, Depth, Degrees of Velocity in Motion, Intenseness or Remissness of Sounds, Augmentation or Diminution of Quality, &c.* it is called *Geometry*.

The Essential Parts of the *Simple or Pure Mathematicks* are *Arithmetick* and *Geometry*, which mutually assist one another, and are independent on any other Sciences, except perhaps on *Artificial Logick*: But doubtless *Natural Logick* may be sufficient to a Man of Sence. The other parts are chiefly Physical Subjects explain'd by the Principles of *Arithmetick* or *Geometry*.

*Artificial Logick* is a System of Rules or Precepts, which teach the right Use of Reason; but *Natural Logick* is that Foundation of good Sence, which makes us naturally discern Truth from Falshood: But as *Mathematicks* is properly a Natural Science, what we advance seems not unreasonable, *viz.* That *Natural Logick* may be sufficient, where there is a Foundation of good Sence to understand it.

By *Simple or Pure Mathematicks* we understand, those parts of it which contemplate Quantity, simply as such, or abstracted from Matter, or any sensible Object.

The *Mathematicks* is divided into *Speculative* and *Practical*.

The *Speculative* parts only contemplate the Truth or Falshood, or respect only the simple Knowledge of a thing proposed.

The *Practical* Teach to do or perform somewhat enjoyn'd, or proposed to be done.

The *Mathematicks* proceeds by *Propositions*, *Demonstrations* and *Principles* whereon all its reasonings are founded and rev.

A *Proposition* is a Discourse which predicates or asserts the Attribute of a Subject, and which is true

true or false. It may be either a *Problem* or *Theorem*, or *Porism*, or *Aporism*, or *Lemmas*, or *Scholium*, or *Corollary*, or *Postism*.

A *Problem* is a Proposition which tends to Practice, as to divide a given right line into as many parts as required. It may be either limited, or unlimited, determin'd, or indetermin'd, or local.

A limited Problem is that which has but one Solution, i. e. which can be done only one way. As to describe an *Equilateral right-angled Triangle upon a line given*, or to *strike a Circle through three Points given*.

By the word *given* in Mathematicks is understood that which is known, either in *Magnitude*, *Position*, *Species* or *Proportion*, &c. that is, whose *Magnitude*, *Position*, *Species*, or *Proportion* is known. When the *Magnitude* is given, we say, *given in Magnitude*; when the *Position*, we say, *given in Position*; when both are known, we say, *given both in Magnitude and Position*; as if you describe a Circle on a Plane, its Center is given in Position, its Circumference in Magnitude, and the Circle both in Magnitude and Position. If you draw any Diameter, that Diameter will be given both in Magnitude and Position. The Circle may also be given only in Magnitude, viz. by conceiving only its Diameter of a given length, and the Circle not as actually described. When its *Species* is known, we say, *given in Species*: and when the Reason of two Quantities is known, they are said to be *given in Proportion*: That is said to be known which we clearly comprehend, and to which we

neither can likewise a right Line, and the Circumference of a Circle.

A *Solid Problem* is that which cannot Geometrically be resolved but by the Intersection of the Circumference of a Circle, and a Conick Section; or by the Intersection of two other Conick Sections besides the Circle. Such is the following Problem which may be easily resolved by the Intersection of a *Parabola*, and a Circle, and which may serve to inscribe a regular *Hepagon* in a given Circle, viz. *To describe a right-lined Isosceles Triangle upon a right line given, where either of the Angles at the base shall be triple of that at the Vertex.* Such likewise is the following Problem which may easily be resolved by the Intersection of a *Parabola*, and an *Hyperbola* between its Asymptotes; and which may serve to inscribe a regular *Nonagon* in a Circle; *To describe a right-lined Isosceles Triangle on a line given, wherein either Angle at base shall be Quadruple of that at the Vertex.* Such likewise is the following Problem, *to inscribe in a given circle a Triangle, whereof the Area and Circumference are given*, which may easily be resolved by the Intersection of a *Parabola*, and a given Circle. It is evident, that a solid Problem can have no more than four Solutions, because two Conick Sections can only intersect one another in four Points.

A *Sursolid Problem* is that which cannot be resolved but by Curves of an higher Gender than the Conick Sections. Such is the following Problem which may easily be resolved by the Intersection of a *Quadratrix*, and any other line of the second

second Gender, and which may serve to inscribe a regular Endecagon ( or figure of eleven sides ) in a given Circle; viz. To describe a right-lined Isosceles Triangle on a right line given, wherein either of the Angles at the base shall be Quintuple of that at the Vertex. What lines of such and such Genera are; see *line*, &c.

An indetermined or local Problem is that which is capable of an infinity of different Solutions, in so much that the Point, which resolves the Problem, when it is in Geometry may be indifferently taken within a certain extent, which may be a Line, or Plane, or Solid, &c. and then we say the Problem is a local one, or in a Geometrick Place.

In the two following Problems, the first is *ad locum in Parabolam*, a Place in the Parabola, the second in a right Line.

A Geometrick Place is therefore a certain Extent, wherein each Point may indifferently solve an indetermined Problem, when it is to be resolved geometrically. All the Points of a Geometrick Place have the same relation to all the correspondent Points of a right Line, as may be seen more at large in Treatises of Geometrick Places.

When the Point that resolves a Problem is in a right Line, the Problem is called a simple Place, or *locus ad lineam rectam*: Such is the following Problem. To find the Center of a Circle, the Circumference whereof shall pass through the Ends of a right Line given in Magnitude and Position. Because that Center is in a right Line.

When the Point that resolves the Problem is in the Circumference of a Circle, the Problem is called

led a *plane Place*, or *locus ad Circulum*. Such is the following Problem; *A Circle and one of its Diameters being given in Magnitude and Position, to find on the same Plane with that Circle, a Point without the Circle, whence if you draw a right Line to one of the two Ends of the given Diameter, that right Line shall be divided into two equal Parts by the Circumference of the given Circle*; because this Point will be in the Circumference of a Circle.

When the Point that resolves the Problem, is in one of the Conick Sections (besides the Circle) then the Problem is said to be *ad lacum solidum, a solid Place*. Such is the following Problem; *To find the Center of a Circle which shall touch a Line given in Position, and also a Circle given both in Position and Magnitude*; because that Center is found in the Circumference of a Parabola, the focus whereof is in the Center of the Circle given, when the Circle and the given Line touch one another. Such also is this Problem; *To find the Center of a Circle, which shall touch two Circles given in Magnitude and Position*: for that Center will be found in the Circumference of an Hyperbola, the focus whereof will be in the Center of one of the two Circles given, when the two Circles touch one another. Such also is the following Problem; *Having a right Line in length and position given, to find a point without that right line, from whence drawing two right lines to the two Ends of the given line, their Sum shall be given, or equal to a given line*: because this Point will be found in the Circumference of an Ellipse.

Lastly, When the Point which resolves the Problem is in the Circumference of a Curve of a higher Gender than the Conick Sections or a line of the first Gender, then the Problem is in a *sursolid Place*. Such is the following Problem; Having given a point and a right line on a Plane, to find on that Plane another Point beyond the given line, so that if a right line be drawn through those two Points, that part of it comprehended between the second Point and the given line shall be given: because this Point will be found in the Circumference of a Conchoid, which is a line of the second Gender.

Several Problems have their Determination or Limits, beyond which they are impossible. Such is the following Problem; To construct a right-lined Triangle of three right Lines given: which Problem is so limited, as to suppose that of the three Lines given, the greatest must be less than the Sum of the other two; because in all Triangles the Sum of any two sides is greater than the third.

When the Point that resolves a Problem is in a Surface, the Problem is called *locus ad superficiem*, a *superficial Place*, or *Place in a Surface*: As the following Problem; To find a Point in a given Parallelogram, through which drawing two right lines parallel to two sides of the Parallelogram, the Parallelograms which shall be thence formed within the given Parallelogram, by the intersection of the two right Lines shall be in Geometrical Proportion: because this Point may be found indifferently any where in the Surface of the Parallelogram given, as is easie to be demonstrated.

Whence

Whence it follows that when the Point which resolves the Problem is in a solid, the Problem is said to be a solid Place: and that when the Problem is Theoretmatical, i. e. when the Problem is really a Theorem, it is also a Place, which shews the Nature of the Problem. Such is the following Problem; *To divide a right Line given in Magnitude and Position, so that the Square of the Whole shall be equal to the Sum of the Square of its two Parts, and two Rectangles under the said Parts.* This Problem being a Theorem, as is evident by the 4. 2. we conclude it to be indeterminate, and that it is *locus ad lineam rectam*, or a Place in a right Line, since it is proposed for a right Line.

An indeterminate Problem may be also proposed in Numbers: as to find two or more square Numbers, whereof the Summ shall be a square Number: or to find three such Numbers as that the Sum and Difference of any two, shall be square Numbers. These two Problems and several others may be resolved indefinitely, that is the Numbers sought may be express'd in Letters, to which you may put what Values you please, to have thereby as many different Numbers as you please, and then such a Solution in Species is called an *indefinite Solution*, whence you draw a general Rule to solve the Problem, called a *Canon*.

The Solution of a Numerical Problem, may be either *Rational* or *Irrational*.

A *Rational Solution* is that which may be express'd in rational Numbers, such as are the Solutions of the two precedent Problems, and of the

following, viz. To find three Cubes, the Summ whereof shall be a Cube.

An Irrational Solution is that which cannot be express'd in Rational Numbers. Such is the Solution of the following Problem, which is determined; To find three Numbers in Geometrical Proportion, whereof the three Differences shall be in Harmonick Proportion, and also inversly; To find three Numbers in Harmonick Proportion, the three Differences whereof shall be in Geometrical proportion.

The Solution of a Geometrical Problem may be either Geometrical or Mechanical.

A Geometrical Solution of a Problem is that which is perform'd by Lines agreeable to the Nature of the Problem: as of a simple Problem, by the Intersection of 2 right Lines: of a plane Problem by the Intersection of a right Line, and the Circumference of a Circle, or by the Intersection of two Circumferences of Circles, and so on. Notwithstanding a simple Problem may be resolved as if it were a plane one, but not a plane one as a solid, nor a solid as if it were a fursolid one.

Thus the Solution of Monsieur Des Cartes for the Invention of two mean Proportionals is a Geometrical one, because he solves it by the Circumference of a Circle and Parabola, which are two lines agreeable to the Nature of the Problem, which is a solid one; but the Solution of Diocles is not a Geometrical one, because he makes use of the Cissoid, which being a line of the second Gender, agrees only to a fursolid Problem.

Archim. de  
Sphera &  
Cylindro.

A Me-

A Mechanical Solution of a Problem is that which is done by Tentation, and also that which is done by any line that is not a Geometrical one. Such is the Solution of *Sporus*, *Eratosthenes*, *Nicomedes*, *Hero*, *Pappus* and *Viete*, for the Invention of two mean Proportionals; because each is perform'd by Tentation. In like manner the Method of dividing any given right-lined Angle into as many equal Parts as required, by means of the *Quadratrix* of *Dinostratus* and *Nicomedes* is also Mechanick, because that Curve is not a Geometrical one.

A local Problem may also be *Simple*, *Plane*, *Solid* and *Sursolid*, according as the Point that resolves it is found in a *Right line*, in the Circumference of a *Circle*, or in the Circumference of a *Solid Line*, or any other of the first Gender besides the Circle, or in the Circumference of any *sursolid* Curve, or of an higher Gender.

The following Problem is a simple local Problem; *To find a Point out of a right line given in Magnitude and Position, from whence drawing two Right lines to the Ends of the given Line, there shall be formed a Triangle of a given Area*, because that Point will be found in a right line parallel to the Line given; as is evident by the 37. 1.

The following Problem is a local plane Problem; *To find a Point out of a right line given in Magnitude and Position, whence drawing two right lines to the Ends of the line given, they shall be perpendicular to one another*; because that Point will be found in the Circumference of a Circle which shall have the given line for Diameter, as is evident from 31. 3. The

The following Problem is a solid local Problem; To find a Point out of a right line given in Magnitude and Position, whence drawing three right lines, to the Ends of the line given, and through its Middle those three right lines shall be in Geometrical Proportion; because that Point will be found in the Circumference of an Equilateral Hyperbola, having the given line for its determinate Diameter.

The following Problem is a local sursolid one; To find a Point within a Right-lined Angle given, through which drawing to one of the two lines of the Angle, a Parallel, which shall meet or occur to the other line, the Cube of that Parallel shall be equal to a solid, under the Square of one of the given lines, and the part of that other line which is terminated by the Point of the Angle and the Parallel; because that Point will be found in the Circumference of a solid Parabola, which is a line of the second Gender.

A Theorem is a speculative Proposition, which expresses the Properties of any Subject; as when we say, that in any Right-lined Triangle, the Sum of the three Angles is equal to two right ones, and that in a spherical Triangle, the Summ of three Angles is greater than two right ones.

A Theorem may be either Universal, Particular, Simple, Compounded, Negative, Local, Plain, Solid, or Reciprocal.

An Universal Theorem is that which extends Universally to any Quantity, without Distinction. Such is this: The Product of the Sum and Difference of any two Numbers is equal to the Difference of their Squares.

A *Particular Theorem* is that which extends only to a particular Quantity, as the following; *Each of the Angles of a right lined Equilateral Triangle consists of 60 Degrees*; and also the following, the Sum of Infinite Fractions, whose Numerators are 1, and their Denominators triangular Numbers 3, 6, 10, &c. is equal to 1.

A *Simple Theorem* is that which considers right lines, as this; *If a line be divided into two Equal and two Unequal parts, equally and unequally, the Rectangle under the unequal Parts, together with the Square of the intermediate Part, is equal to the Square of half the line*: and also the following, if a line be divided in mean and extreme Reason, the Square of the whole, together with the Square of the Lesser Segment is triple the Square of the other Segment.

A *Compounded Theorem* is that which consists of several Parts, as the following; *The Sum of the three Angles of a spherical Triangle is greater than two right ones, and less than four right ones*; and also the following; of two rational Numbers either one of the two, or their Sum, or their Difference is divisible by three.

A *Negative Theorem* is that which pronounces the Impossibility of a Question, as the following; *The Sum of two Biquadratick Numbers cannot be a Square*; and also the following, there cannot be had two rational Numbers, the product whereof being added to the Square of the least, and subtracted from the Square of the greatest, the Sum and Remainder shall be square Numbers.

A Local Theorem is that which relates to a Surface, as the following; Triangles describ'd on the same base, and between the same Parallels are equal.

A Local Theorem may be either Plain or Solid.

A Plain Theorem is that which relates to a Surface terminated by right lines as the Precedent, or by the Circumference of a Circle, as the following; All the Angles in the same Segment of a Circle are equal.

A Solid Theorem is that which relates to a Space terminated by a solid Line; that is by any other Conick Section besides the Circle, as the following; If there be drawn any right line which cuts two Asymptotic Parabola's, the two parts of that right line, terminated by the two Parabola's, shall be equal.

A Reciprocal Theorem is that whereof the Reverse is also true, such is the following Theorem; A Triangle which has two equal Sides has also two equal Angles, the Reverse whereof is also true, viz. A Triangle which has two equal Angles has also two equal Sides.

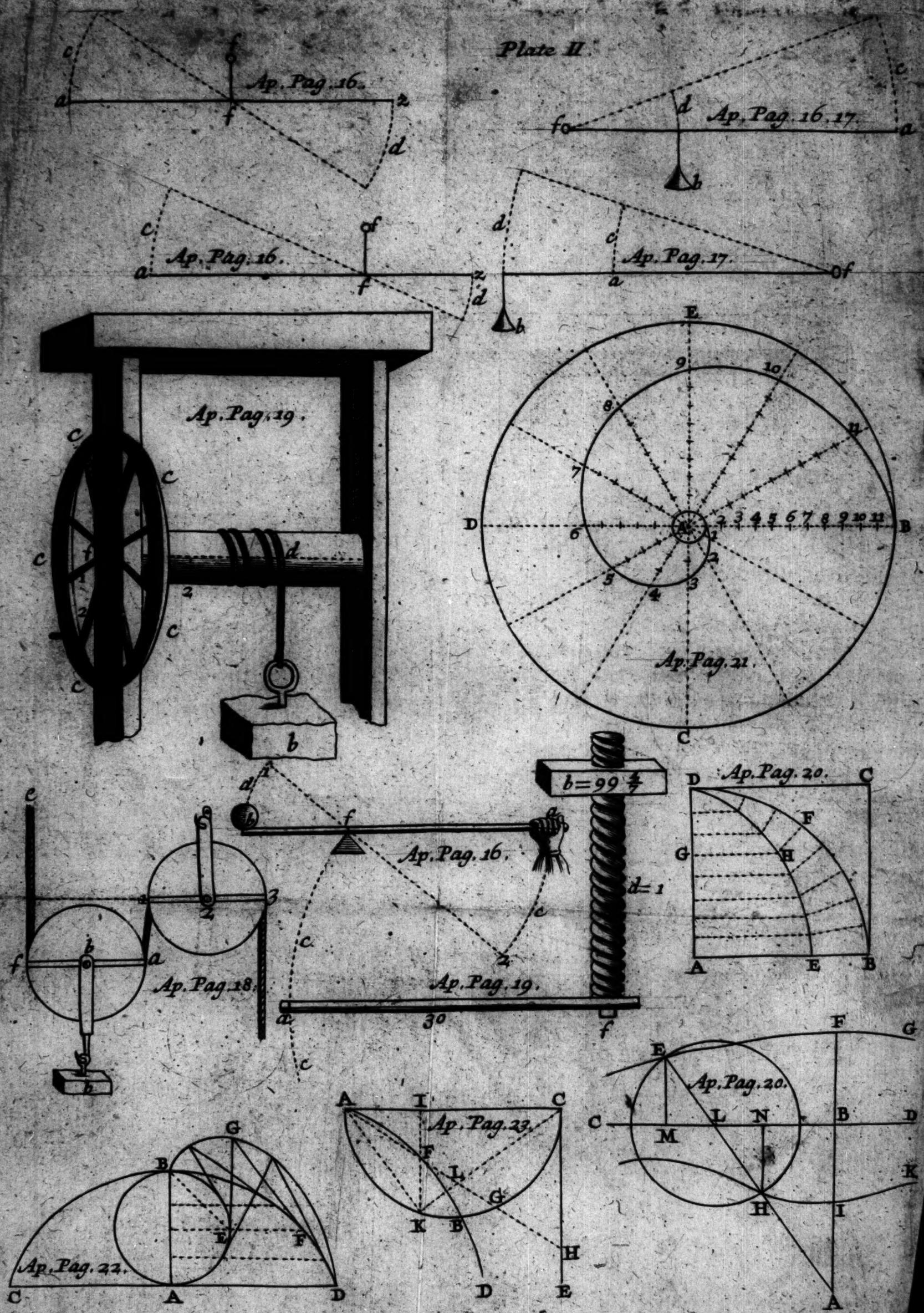
A Porime (Πόεμα) is an easie Problem and almost self-evident, and which is of use for the Solution of more Difficult; as to strike the Circumference of a Circle through two Points; or to cut off from a given line any given part. Any Theorem that is easie to be demonstrated, and almost self-evident, may also be called a Porime such is the following; a right line which joins two Points taken at pleasure in the Circumference of a Circle, is wholly within that Circle; and also the following; if from the greatest Angle of a right lined Triangle,

you

you let fall a Perpendicular to the greatest side, that Perpendicular will fall within the Triangle. For *Porime* comes from the Greek word Πόριμος, which signifies a thing easy to be comprehended, and which opens a way to a more difficult one; and consequently an *Aporim* is a Problem very difficult to be resolved, and which has not as yet ever been resolved, although possible to be done; as the *Quadrature of the Circle*. Before Archimedes the *Quadrature of the Parabola* was an *Aporim*.

A *Lemma* is a Proposition which serves for the Demonstration of a Theorem, or Construction of a Problem. It is made use of to render the Demonstration less perplexed, or a Construction easier to be comprehended; as may be seen in the following Problem. Thus to demonstrate that a *Pyramide* is  $\frac{1}{3}$  of a *Prism* of the same *Base* and *Altitude*, This *Lemma* may be premised that the *Sum of the Squares of infinite Quantities in continual Arithmetical Proportion*, beginning from 0 is equal to  $\frac{1}{3}$  of the greatest Term or *Square* multiplied by the Number of Terms. It is evident also that this *Lemma* may be demonstrated reciprocally by means of the preceding Theorem, which may also serve for a *Lemma* to it. Thus also to draw a Perpendicular through a given point to a given right line, Euclid teaches, before he teaches to describe an *Equilateral Triangle* on a line given. Thus also to find the point of *Inflection* of a *Curve* line that has one, we make use of this *Lemma*; To draw a right line which shall touch a given *Curve* in a given Point; as is taught by *Messieurs Des Cartes and Fermat*.

Plate II.



The Point of Inflection of a Curve, is that where the Curve begins to bend back again a contrary way: As in the Geometrical Quadratrix, the Coneboid and solid Paraboloid, which has a Square for its Parameter, and has its Point of Inflection at its Vertex, and in several others which have several Points of Inflection, as in the solid Hyperboloid, &c. We say a Curve line is given, when the Essential Property of it is known; and when the Species is known we call it given in Species, as also any other Figure whose Species is known.

A Scholium is a Note or Remark made, as it were by the by on any Subject or Discourse.

A Corollary is a Consequence drawn from what has been already proposed and demonstrated: As if from hence because a Triangle which has two sides equal, has also two Angles equal, we should draw this Consequence, Therefore a Triangle which has its three Sides equal, has also its three Angles equal.

A Porism is a general Theorem, which is discovered from a Geometrick Place found. That is, when one has found by Algebra, or otherwise, the Construction of a local Problem, and from that Place constructed and demonstrated a general Theorem is deduced, that Theorem is called a Porism.

Wherefore a Porism is properly a Corollary in form of a Theorem, which is discovered from a Place found and demonstrated, and which may serve, according to Pappus, for the Solution of the most general and difficult Problems.

27. We have found several, which are of great use when we have to handle problems the Reader with more ease: we may the better comprehend what a *Postulate*? the word comes from the Greek *μαζί*, which according to Proclus, signifies to establish or conclude from what has been done and demonstrated, which he defines a *Postulate* to be a Theorem deduced by occasion of some other Theorem already done and demonstrated.

### L E M M A.

If through the Point D, taken at Discretion in the Circumference of the Parabola ADB, there be drawn the right line DF parallel to the Diameter GH, the diameter whereof is HI, and terminated in F by the right line AB, which is an ordinate to the Diameter GH, the reason of the two lines HI, and FI is equal to that of the two lines BF, DF.

28. For the Demonstration, draw from the Point D, the right line DL parallel to the ordinate AB.

### D E M O N S T R A T I O N.

Since the line AB is an ordinate to the Diameter GH, it will be divided into two equal parts at the point G, by that Diameter, viz. GH, and by the 1. 2. you'll have this Equality AFB + FGq — v. Gq: wherefore if in room of the Square of FG, <sup>square of the</sup> the Square of DL, you put the Rectangle of HIHL, and in room of the Square of G the Rectangle HIHG, which is equal to it by the Nature

ture of the *Parabola*, you'll have this Equality  $AFB + HIHL = HIHG$ , and taking away the Rectangle  $HIHL$ , you'll have  $AFB = HIHG - HIHL = HIGL = HIDE$ . Wherefore by the 14. 6. the 4 lines  $HI$ ,  $AF$ ,  $BE$ ,  $DF$ , will be proportional Q. E. D.

~~whereas the two arms HI and BE are not base to CD, E~~ **COROLLARY.** ~~whereas base~~

From this Theorem may be deriv'd an easy Method to find the Parameter to a given Diameter in a given *Parabola*. As if there be given the Diameter  $HS$  of the given *Parabola*  $RHM$ ; to find the Parameter of it, draw to the given Diameter  $HS$  an Ordinate  $RM$ , with another Diameter  $DT$ , terminated by the Ordinate  $RM$  in  $T$ , and by the *Parabola* in  $D$ , and find to the three lines  $DT$ ,  $MT$ ,  $RT$ , a fourth proportional  $HI$ , which will be the Parameter sought, which may also be found yet easier, viz. by finding to the two lines  $HS$ ,  $RS$ , a third Proportional.

### PROBLEM.

To find in a given Triangle  $ABC$ , the point  $D$ , through which drawing parallel to the side  $BC$ , a right line  $EF$  terminated by the two other sides  $AB$ ,  $AC$ ; the reason of the two parts  $AF$ ,  $BF$  shall be equal to that of  $DE$ ,  $EF$ .

To resolve this Problem Analytically, that is to say, by Algebra, make

$$\mathbf{AB} = a$$

$$\mathbf{BC} = b$$

$$\mathbf{DF} = x$$

$$\mathbf{AF} = y$$

$$\mathbf{AG} = \frac{1}{2}a = \mathbf{BG}$$

$$\mathbf{GH} = \frac{1}{4}b$$

$$\mathbf{GF} = z = y - \frac{1}{2}a$$

and then the other lines will come out as under,  
and because the 4 lines  $\mathbf{AF}$ ,  $\mathbf{BE}$ ,  $\mathbf{DE}$ ,  $\mathbf{DF}$ , or  $y$ ,

by

$$\mathbf{y} = x, x, x,$$

$$\mathbf{AB} = a$$

$$\mathbf{BC} = b$$

$$\mathbf{DF} = x$$

$$\mathbf{AF} = y$$

$$\mathbf{EF} = \frac{a}{2}$$

$$\mathbf{DE} = \frac{a}{2} - x$$

$$\mathbf{BF} = \frac{a}{2} - y$$

$$\mathbf{AG} = \frac{1}{2}a = \mathbf{BG}$$

$$\mathbf{GH} = \frac{1}{4}b$$

$$\mathbf{GF} = z = y - \frac{1}{2}a$$

by

$$\mathbf{EF} = \frac{a}{2}$$

by

$$\mathbf{DE} = \frac{a}{2} - x$$

by

$$\mathbf{BF} = \frac{a}{2} - y$$

ought to be proportional, you'll have this Equation

$$xy = by - ax$$

$$+ xy$$

$$- a$$

$$+ aax$$

$$- zy +$$

$$- b$$

$$= 0,$$

which is  
Locus ad  
Parabolam,  
or place in a Parabola as may be known by supposing  
 $y - z + \frac{1}{2}a$ , to obtain this other Equation

Now since the Parabola  $\text{AHB}$

$\therefore \frac{AG}{AB} = \frac{2a}{2a+b}$ , which belongs to a Parabola, the Parameter whereof is  $\frac{2a}{b}$  whence we have deduced this

## CONSTRUCTION.

Having drawn through the point  $G$ , viz the middle of the line  $AB$ , the right line  $GH$  parallel to the line  $BC$ , and equal to a quarter of the line  $BC$ , describe through the three points  $A, H, B$ , upon the Diameter  $GH$ , the Parabola  $AHB$ , which will be the Place sought. Inasmuch that if through the point  $D$  taken at pleasure in the Circumference of that Parabola, you draw the right line  $EF$  parallel to the side  $BC$ , the four lines  $AF, BF, DE, DF$  will be proportional.

For the Demonstration draw the Parameter  $HI$ , to the Diameter  $GH$ .

## DEMONSTRATION.

In the similar Triangles  $ABC, AEF$  you have this proportion  $AB:BC::AF:EF$ , wherefore taking one half of the Antecedents, and  $\frac{1}{2}$  of the Consequents you'll have this other proportion  $AG:GH::AF:EF$ : and if in room of the two first Terms  $AG, GH$ , you put these two  $HI, AG$ , which are in the same proportion, by the Nature of the Parabola, you'll have this other proportion

on HI: AG :: AF: EF, and doubling the two last Terms, you'll have this proportion HI: AG :: AF:  $\frac{1}{2}$  EF, and doubling the two Consequents, you'll have this HI: AB :: AF: EF, and putting in room of the two Antecedents HI, AF, the two Quantities BF, DE, which are in the same proportion by the precedent *Lemma*, you'll have this Analogy BF : AB :: DF : EF, and lastly by dividing, you'll have this AF : BF :: DE : DF. Q. E. D.

This Proposition is demonstrated after another way by Archimedes in Prop. 5. of the Quadrature of the Parabola, and also after another way by Gregory San-Vincent in Prop. 92. of the Parabola, where he supposes, with Archimedes, that the side AG touches the Parabola in the point A, which is evident by our Construction. I shall leave it to the Reader to decide which of our Demonstrations is the more simple.

AG and considerately to the two lines  
**PORISM 1.** OH, HN

The reason of the two lines NO, PQ is equal to  
that of the two Ordinates DL, MS.

**PORISM 2.**

The reason of the two lines HO, HO is equal to  
that of the same two Ordinates DL, MS, and by  
consequence to the two lines NO, PQ.

**PORISM 3.**

The Reason of the two lines, HN, HP, is  
equal to that of the same two Ordinates DL,  
MS, and consequently to that of NO, PQ.

**PORISM 4.**

The Reason of the two lines NP, OQ, is  
equal to that of the two Ordinates KV, AG.

**PORISM 5.**

The Reason of the two lines HP, HQ, is  
equal to that of the same two Ordinates KV,  
AG, and consequently to that of the two lines  
NP, OQ.

**PORISM 6.**

The Reason of the two lines HP, HQ, is  
equal to that of the same two Ordinates KV  
AG.

AG, and consequently to that of the two lines HN, HQ.

We might give the Demonstrations of all these Porisms, and shew the way how they were found out, but we shall at present go no farther.

A *Demonstration* is one or more Arguments, drawn the one from the other, which clearly and infallibly demonstrate the Proposition in hand. This sort of Ratiocination is founded on three sorts of Mathematical Principles, which we will presently set before the Reader. They are made use of to shew the Truth or Falshood, Possibility or Impossibility of a Proposition: For without Demonstration there remains always room for Doubts and Scruples, especially if the Proposition be not a first Principle it self; for a Proposition often happens to be false though it appear true to Sense and Reason at first sight.

A *Demonstration* may be *Affirmative* or *Negative*: *Geometrical* or *Mechanical*: *Particular* or *General*.

An *Affirmative Demonstration*, is that which by affirmative and evident Propositions, which depend one upon the other, concludes with that which was to be demonstrated; such are the two precedent Demonstrations.

A *Negative Demonstration* is, that by which we are shewn that a thing is so from some Absurdity, that would follow if it was supposed to be otherwise. Thus, to demonstrate that a Triangle which has two Angles equal, has also two Sides equal, Euclid shews the Contradiction which would follow

low, if one of those two sides were greater than the other, thence to conclude that they are equal. This sort of Demonstration is commonly called *Deductive ad impossibile*, or *Apagogical*, that is deductive to an *Absurdity* or *Impossibility*.

A Geometrical Demonstration is that which is formed by Ratiocinations drawn from Euclid's Elements: Such are the two precedent Demonstrations, and all those of Euclid's Elements, and several others.

A Mechanick Demonstration is that, whose Ratiocinations are drawn from Rules of Mechanicks. As if to demonstrate, *That three right Lines drawn from the three Angles of a right-lined Triangle, through the Middle of the opposite sides intersect one another within the Triangle*; a Man should make use of this Proposition of Mechanicks, viz. *That the Center of Gravity of a Triangle is in a right line drawn from any Angle through the Middle of the opposite side*.

A Particular Demonstration is that which is concluded by means of some particular Theorems, as so many Lemma's. Such is the Demonstration of the *Quadrature of the Parabola* by Archimedes, which only agrees to the common *Parabola*.

A General Demonstration is that which is concluded by means of a general Theorem, as a *Lem-ma*, or *Medium*. Such is the modern *Quadrature of the Parabola*, which may be applied to any or infinite *Parabola's*.

A Demonstration has commonly three parts, viz. the *Explication*, the *Preparation*, and the *Conclusi-*  
*on.*

The

The *Explication* is the Exposition of the Matter supposed to be given in the Proposition, *viz.* of the thing to be demonstrated; from 1 to 110 and the *Interpretation* is commonly some lines that are requisite to be drawn in the Figure, when the Proposition is to be demonstrated *Geometrically*, as may be seen in the two precedent Demonstrations; or some other Supposition which we may be obliged to make, when the Proposition to be demonstrated is an *Arithmetical* one, thereby to come the more easily to the Demonstration.

The Conclusion is a Proposition (or Enunciation) which concludes the thing to be demonstrated, and which serves to convince the Truth of the Proposition.

A Principle is something that is self-evident, or shines by its own light, or is naturally known to the Understanding. The Mathematicians make use of three sorts, viz. Definitions, Axioms, and Postulates or Demands.

Definitions are the Explications of words, and terms made use of to explain the things treated of. Thus to understand Arithmetick, it is requisite to be known what a Number is, and what a Fraction, &c. In like manner to understand Geometry, it must be known what is meant by a Line, a Plain, a Solid, &c. &c. is to answer and be able to Definitions, which are commonly called Common Propositions are such Propositions as are self-evident, and which cannot be denied without renouncing both Reason and Sense. Thus there is no Person who is not sufficiently convinced, That the whole is greater than its part.

*Axioms* are also called *Maxims*, because they serve generally for all Demonstrations.

*Postulates* or *Demands*, are Suppositions so easie and evident that they have no need of any Illustration or Explication to be understood: As, *To draw a right Line from one Point to another*, *To describe a Circle from any Point given, of any given Magnitude*: *To conceive that a possible fourth Proportional may be found to any three given*, &c.

There are two general Methods made use of in the Mathematicks, *viz.* *Synthesis* and *Analysis*, which we shall explain, after having acquainted the Reader, that the Method we make use of to resolve a Mathematical Problem, is called *Zeretick*; and that that Method which determines when, and by what way, and how many different ways a Problem may be resolved, is called *Paristick*. But in treating of Methods, we will first premise, that in general, a *Method* is the Art of disposing a Train of Arguments or Consequences in a right Order, either to discover the Truth of a Theorem, which we would find out, or to demonstrate it to others when found.

*Synthesis* or *Composition* is the Art of searching the Truth or Demonstration, the Possibility or Impossibility of a Proposition, by reasons drawn from Principles, that is by Propositions which demonstrate one another, beginning from the most simple, and so going on to more general and compounded ones, not interposing any that is not necessary, till at length you arrive to the last Proposition designed, or *Conclusion* which is the thing to be demonstrated, and so attain to a clear and distinct

inct Knowledge of the Truth sought, as may be seen in the two preceding Demonstrations, which were performed by the Method of *Composition*; which you shall also see further exemplified in the following Problem, wherein we make use of the Method of *Synthesis* or *Composition*, and of *Analysis* or *Resolution*.

*Analysis* or *Resolution* which also may justly be termed the *Method of Invention* is the Art of discovering the Truth or Falshood, the Possibility or Impossibility of a Proposition in an order contrary to that of *Composition*, viz. By supposing the Proposition already done, and then examining the Consequences that follow from it as done, till you come to some known and evident Truth, or Impossibility, whereof that which was proposed is a necessary Consequence, thence concluding the Truth or Impossibility of the Proposition; which may then be demonstrated in a Retrograde way of *Composition*, by re-assuming the same Steps backward again, beginning where you ended.

The Method of *Analysis*, or *Analyzing a Question*, consists more in the Judgment, and Readiness of Apprehension in the *Analyst*, than in any particular Rules, when we make use of pure Geometry, as did the Ancients; but at present we make use of *Algebra* therein, which furnishes us with certain Rules and Methods to perform or arrive to what was proposed, as may be seen in the precedent Problem, and also in the following, which is a local one.

of giving out a ready reckoning to be made in  
-is one ratio of means of the last four  
-four PRO-

PROBLEM.  $\frac{BG}{GH} = \frac{AE}{DE}$

To find in a right-lined Angle given  $\angle ABC$ , the Point  $D$ ; whence drawing the right Lines  $DE$ ,  $ADF$  perpendicular to the lines  $AB$ ,  $BC$ ; the Sum of the two lines  $AE$ ,  $DF$  shall be equal to the Sum of the two lines  $BF$ ,  $DE$ .

To resolve this Problem Analytically, by the Modern or Specious *Algebra*, draw from the Point  $G$  taken at pleasure on the line  $BC$ , the right line  $GH$  perpendicular to the other line  $AB$  of the given Angle  $\angle ABC$ . After that make

$$BG = a$$

$$GH = b$$

$$BH = c$$

$$DF = x$$

$$BF = y$$

and then the other lines will be found as you find them marked on the side of the Figure; and because the Sum of the two lines  $AE$ ,  $DF$ , ought to be equal to that of  $DE$ ,  $BF$ , you'll have this E-

$$\frac{bby}{ac} + \frac{bx}{a} = \frac{by}{a} + \frac{y}{a} \text{ or, } x -$$

$$acy + bcy = bby \text{ which is locus ad lineam rectam,}$$

$cc + ac = bc$  or a place in a right line, the Construction whereof is thus:

BG

$$\frac{BG}{GH} : a : BH : GH :: BF : AB$$

PROBLEM.

To find a point  $x$  in the line  $AB$  such that  $BG$  is to  $x$  as  $BH$  is to  $GH$ .  
 Point  $D$  is drawn in the right line  $DE$  such that  $DE$  bears to  $BC$  as  $BH$  bears to  $GH$ .  
 Therefore  $AD$  is to  $x$  as  $BH$  is to  $GH$ .  
 Sum of the lines  $DE$ ,  $DF$ .

$$BG :: GH : AD : AE$$

To find a point  $x$  in the line  $AB$  such that  $AD$  is to  $x$  as  $BH$  is to  $GH$ .  
 Point  $D$  is drawn in the right line  $DE$  such that  $DE$  bears to  $BC$  as  $BH$  bears to  $GH$ .  
 $BG : BH :: AD : DE$   
 by  $cxa$  by  $cx$

$$:: — by —$$

$$cxa : a$$

$$AE + DE : DE + BF.$$

$$bby : bx$$

$$\frac{bby}{ac} + x = \frac{bx}{a} + y$$

$$a$$

## CONSTRUCTION.

Make the Right-angled Triangle  $BIK$ , so that  $BI$  shall be to  $IK$ , as  $BHq + BGBH - BHGH$  to  $BGBH + BHGH - GHq$ , and the Hypotenuse  $BK$  being prolonged towards  $L$ , as far as you will, will be the place sought: So that if you take a Point therein at pleasure as  $D$ , thence to draw to the lines  $AB$ ,  $BC$  the Perpendiculars  $DE$ ,  $DF$ , and

and if you also produce DF till it meet AB in any Point, as e.g. ~~in the Sum~~  $AB + DE$ , will be equal to the Sum  $BF + DE$ , as we will demonstrate Synthetically.

**DEMONSTRATION.**

In the similar Triangles BIK, BFD, if you have this Proportion  $BI : IK :: BF : DF$ ; wherefore, if instead of the two former Terms BI, IK, you substitute these two  $BHq + BGBH - BHGH$ ,  $BGBH + BHGH - GHq$ , which are in the same Reason, by the Construction, you'll have this other Proportion,  $BHq + BGBH + BHGH : BGBH + BHGH - GHq :: BF : DF$ , and by the ~~134, 11.~~ you'll have this Equality,  $DFBHq + DFBGBH - DFBGH - BFBGBH + BF - BHGH - BFGHq$ ; and adding  $BFGHq$ , and taking away  $DFBH$ , you'll have this Equality  $BFGHq - DFBGH + DFBGBH - BFBGBH + BF - HGH - DFBHq$ , and if in room of the Plane  $BFGH$ , you put what is equal to it,  $AEBH$ , because these four lines  $BH, GH, BF, AF$  are proportional, by reason of the similar Triangles  $BGH, ABE$ , and if you change  $AF$  into  $DF$  into  $AD$ , and cut off from the whole the common height  $BH$ , you'll have this other Equality  $ADGH + DFBG = BFBG + ADBH$ , and if you change the Plain  $ADGH$  into its equal  $AEBG$ , and the Plain  $ABDH$  into its equal  $DEBG$ , because of the similar Triangles  $BGH, ADE$ , and cut off the common height  $BG$ , you'll have this last Equality  $AE + DF = BF + DE$ , which was to be demonstrated.

SCHO.

## SCHOOLIUM.

Having found by the precedent Analysis, that the Point sought is in a Right-line, which passes through the given Angle B, it will suffice to find a Point of that line on some other Perpendicular to the line BC, as D upon the Perpendicular AP.

To that End draw from the Point F the Right-line FM, perpendicular to the line AB, and make

$$BF = a \quad BF : FM :: AD : AE$$

$$FM = b \quad a : b :: x :$$

$$BM = c \quad BF : BM :: AD : DE$$

$$AF = d \quad a : b : c : x :$$

$$AD = x \quad DE : BM :: AF : BF$$

$$Therefore DF = d - x$$

and then the other lines will be as you see them here marked; and because the Sum  $AE + DF$ ,

ought to be equal to the Sum  $BF + DE$ , you'll

have this Equation,  $\frac{a}{a} + d - x = a + \frac{c}{c}$ ,

$$ad - ax = ac$$

wherein you'll find  $x = \frac{ad - ac}{a - b + c}$ :

reducing that Fraction into a Proportion, you will

have

have this Analogy  $a - b + c : a :: d - a : x$ , and by dividing you'll have this  $b - x : a :: x + a - d : x$ , or  $EM - BM : BF :: BF - DF : AD$ , whence may be drawn this

### Other CONSTRUCTION.

Having drawn from the Point  $F$  taken at Pleasure in the line  $BC$ , the right lines  $FA, FM$ , perpendicular to the two lines  $BC, BA$ ; To the three Lines  $FM - BM, BF, BF - DF$ , find a fourth proportional  $AD$  for the point  $D$  through which, and through the given Angle  $B$ , draw the local line  $BDZ$ , which will be the same as before, so that the Sum  $AE + DF$  shall be equal to the Sum  $BF + DE$ .

### DEMONSTRATION.

Since by the Construction we have this Analogy,  $FM - BM : BF :: BF - DF : AD$ ; if instead of the two first Terms  $EM - BM, BF$ ; you put these two,  $AE - DE, AD$ , which are in the same reason, because of the similar Triangles  $ADE, BFM$ , you'll have this other Analogy  $AE - DE : AD :: BF - DF : AD$ , and consequently this Equality  $AE - DE = BF - DF$ , or  $AE + DF = BF + DE$ , which was to be demonstrated.

Without the precedent Analysis, you may find the same Construction by the Analysis of the Ancients, by supposing the Problem already resolved, and then reasoning after this manner.

D

Since

Since the Sum  $AE + DE$  is equal to the Sum  $BF + DE$ , the Difference  $AE - DE$  will be equal to the Difference  $BF - DF$ , and we may make this Analogy  $AE - DE : AD :: BF - DF : AD$ ; and if in room of the two former Terms  $AE - DE$  and  $AD$ , you put these two  $FM - BM$ ,  $BF$ , which are in the same reason, because of the similar Triangles  $ADE$ ,  $BEM$ , you'll have this other Analogy,  $FM - BM : BF :: BF - DF : AD$ , which shews that to find the point  $D$ , you must find a fourth proportional  $AD$ , to the three lines  $FM - BM$ ,  $BF$ ,  $BF - DF$ , as has been done.

When we make a Demonstration from any Geometrical Figure whatever, we suppose the Figure to be infinitely more exact than it appears on the Paper, *viz.* such exactly as the Soul conceives it to be, and this we call an *Hypothesis*.

Wherefore an *Hypothesis* is a supposition of that which is not, for that which may be. Whence it follows that it is not necessary that the Hypothesis should be true, but it is sufficient that it is possible: Whence it follows that there may be several Hypotheses on the same Subject. Thus the same line may be supposed one while Right, and another Curve or Crooked, sometimes the Circumference of a Circle, and sometimes of an Ellipse, &c. because it may be such.

An

An Hypothesis is almost the same thing as a *System*, which is also a Supposition ; the Difference is this, that a System, is a Supposition of a larger Extent, and that we seldom make use of that word in the Mathematicks, except in respect of the Universe, as far as it relates to the Dispositions of the Heavens, and Motions of the Stars. There are three famous Systems of the World, whereof we shall give an Epitome under the word System.

We shall only give you here further a little insight into the Method which Mathematicians call or entitle *De Maximis & Minimis*, which is the Method of resolving a Problem, by giving the greatest or least Quantity of all those that are obtainable by its means. This will be better comprehended by the two following Examples.

### PROBLEM I.

To draw through the right Angle C of a given Rectangle ABCD the right line EF, terminated in E and F by the two sides prolonged AB, AD; so that the Sum of the Squares CE, CF shall be the least of all possible.

To resolve this Question, let us determine the Sum of the Squares CE, CF in supposing it equal to the Square of a given line, as suppose AJ.

If you suppose  $BC = a$ , and  $CD = b$ ,  $AG = c$ ,  
 $ab$   
 and  $BE = x$ , you'll have  $DF = \frac{ab}{x}$ ,  $CEq = xx + aa$ ,  
 $x$   
 and  $CFq = \frac{aabb}{xx} + bb$ , and consequently this  
 $aabb$   
 Equation  $xx + aa + \frac{aabb}{xx} + bb = cc$ , or  $x^4 +$   
 $xx + bbxx - ccxx - aabb = 0$ , wherein you'll  
 find  $xx = \frac{1}{2}cc - \frac{1}{2}aa - \frac{1}{2}bb + \frac{1}{2}\sqrt{c^4 - 2aacc - 2bbcc - 2aabb + a^4 + b^4}$ . Whence reducing it  
 from its Surdity, since it is a Square, that the Quan-  
 tity  $c$  may become the least, by this Equation  $c^4 -$   
 $2aacc - 2bbcc - 2aabb + a^4 + b^4 = 0$ , wherein  
 you'll find  $c = a + b$ , and then you'll find  $c = \sqrt{ab}$ ,  
 which shews that the line  $BE$  is a mean propor-  
 tional between  $AB$ ,  $BC$ .

### CONSTRUCTION.

If therefore you take on the line  $AB$  produced,  
 the line  $BE$  a mean proportional between  $AB$ ,  $BC$  ;  
 and draw from the point  $E$  to the given point  $C$ ,  
 the right line  $ECF$ , the Sum of the Squares  $CE$ ,  
 $CF$  will be the least of all, as for Example less than  
 the Sum of the Squares  $CG$ ,  $CH$ , having drawn  
 through the given Point  $C$  any other line  $GH$ .

## *DEMONSTRATION.*

In the similar Triangles EBC, CBF you have this proportion BEq or BCD : BCq :: DCq : DFq, and because of the height BC, which is common to the two first Terms you'll have this proportion, CD : BC :: CDq : DFq, and if you add to the first two Terms the common height CD, you'll have this proportion CDq : BCD :: CDq : DFq, and consequently DFq = BCD, and because you have also BEq = BCD by the Construction, it will be known that the two lines BE, DF are equal.

In the similar Triangles GBC, CDH you have this proportion BG : BC :: CD : DH, and consequently this Equality BCD = BGDH, and as we have 2BGDH less than BGq + DHq by 4, 2. we shall have 2ECD or BEq + DFq less than BGq + DHq, and adding BCq + CDq, we shall have CEq + CFq less than CGq + CHq, which was to be demonstrated.

## *PROBLEM 2.*

*To draw within the given Semi circle ABC a right line BD perpendicular to the Diameter AC, so that the Rectangle ADB shall be the greatest possible.*

Let us determine the Problem as before, by supposing the Rectangle ADB to be equal to the Square of the given line AN.

D 3

If

If you suppose the Semi-diameter  $AE$ , or  $EC$ , or  $EB = a$ ,  $AN = b$ ,  $ED = x$ , and  $BD = y$ , you'll have  $AD = a + x$ , and in the Right-angled Triangle  $EDB$ , you'll find this Place in a given Circle,  $xx + yy = aa$ : And because the Rectangle  $ADB$  ought to be equal to the Square  $AN$ , you'll have this Place in an *Hyperbola* between its *Asymptotes*  $ay + xy = bb$ .

To joyn together these two Places, draw from the Point  $A$ , the indefinite Line  $AK$  Perpendicular to the Diameter  $AC$ ; and from the Point  $N$ , the right line  $NO$  Perpendicular and equal to the line  $AN$ , and describe from the Center  $A$ , through the Point  $O$ , within the Asymptotes  $AC$ ,  $AK$ , the Hyperbola  $LOM$ , which shall meet the given Circle in the Point  $B$ ; whence draw the right line  $BD$ , perpendicular to the Diameter  $AC$ , and the Rectangle  $ADB$  will be equal to the Square  $AN$ , since it is equal to the Rectangle  $ANO$ , by the property of the Asymptotes.

### PROBLEM

It is evident when the Rectangle  $ADB$  is the greatest of all, in which Case the line  $AN$  will be the greatest of all also, the Hyperbola will touch the Circle only in one Point, as in B, which we shall find thus.

Having drawn through the Point of Contact  $B$ , the right line  $KL$ , perpendicular to the Radius

dius EB, it will touch the Circle and Hyperbola in the same Point B, and the two lines AD, DI, will be equal, by the Property of the Asymptotes; and by reason of  $AD = a + x$ , you'll have also  $DI = a + x$ , and in the Right-angled Triangle EBI, you'll have  $yy = ax + xx$ : and because in the Right-angled Triangle EDB, you'll find  $yy = aa + xx$ , you'll have this Equation  $aa + xx = aa - xx$ , in which you'll find  $x = \frac{1}{2}a$ , which shews that the line ED is equal to half the Radius EC, and consequently the Arch BC is 60 Degrees.

## CONSTRUCTION.

If therefore from the Point D, in the Middle of the Radius EC, you draw the right line DB perpendicular to the same Radius EC, the Rectangle ADB, will be the greatest possible, as for Example greater than the Rectangle AGF, drawing any right line GH perpendicular to the Diameter AC.

## DEMONSTRATION.

For the Demonstration produce the Diameter AC to I, so that the lines AD, DI may be equal, and join the right line BI, which shall touch the given Circle ABC in the Point B, as may be easily known by drawing the right line AB. Describe also through the Point B, between the Asymptotes AI, AK, the Hyperbola CBM, which will touch

the line BI, in the Point B, because of the two equal lines AD, DI; whence it also follows it will touch the given Circle ABC, in the same Point B.

This preparation being made, you must consider, that since the Rectangle ADB is equal to the Rectangle AGH, by the Nature of the Asymptotes, and that the Rectangle AGH is greater than the Rectangle AGF, the Rectangle ADB will be also greater than the said Rectangle AGE; which was to be demonstrated.

### CO-NSTRUTION

### DEMONSTRATION

ÆR

Day of the Month, Year  
Signature and the  
Name of the Member, Member  
and People, Member of  
Board of Directors A. B.  
the Work of the Church  
and the People, Member of  
the Board of Directors A. B.  
the Work of the Church  
and the People, Member of  
the Board of Directors A. B.

**A** *Baft or Aft* (in Navigation) towards the Stern of the Ship, as the Mast hangs *Abaf*, i. e. towards the Stern.

*Achronical, Rising and Setting of Stars, when a Star rises when the Sun sets, it is said to rise Achronically, and the Converse.*

*Addition, is the Collection of several Numbers into one Sum, and may be either Simple or Compound.*

*Addition Simple*, is the Collection of several things of the same kind into one Sum; as Pounds, Shillings, or Pence separately.

*Addition Compound*, is the Collection of things of different Species into one Sum; as of Pounds, Shillings and Pence all together.

*Addition of Reasons: See Reason.*

*Era's* or *Epocha's*, are certain Periods of Time, whence Chronologers begin to compute or count. To omit others, the Christian *Era* or *Epocha* is that now in use amongst us, which

**begins from the Nativity of  
our Lord.**

## *Festival or Summer Solstice: v. Solstice.*

*Africa, one of the four  
Parts of the World, and the  
greatest Peninsula in it.*

Aggregate, the Summ or Total of any kind of things added together.

Algebra, from *Al* in Arabic which signifies Excellent, and *Geber* the Name of the supposed Inventor of it, is a Science of Quantity in general, whence it has also got the Name among some of *Mathesis Universalis*, & is chiefly conversant in finding Equations, by comparing of unknown and known Quantities together, whence also by some it is called the Art of Equation, and is distinguished into,

— *Numeral*, which is the more ancient, and serves for the Resolution of Arithmetical Problems: For this see *Diophantus*.

— *Speciosa*, or the new  
Algebra, which is also called  
*Logistica Speciosa*, and is  
con-

conversant about Quantity denoted by General or Universal Symbols, which are commonly the Letters of the Alphabet; and serves indifferently for the Solution of all Mathematical Problems, whether Arithmetical or Geometrical.

*Algorithm*, otherwise called *Logistica Numeralis* is the Foundation of Numeral Computation, and contains the six Principal Rules thereof, viz. *Numeration*, *Addition*, *Subtraction*, *Multiplication*, *Division* and *Extraction of Roots*.

*Aldebaran*, the Bull's Eye, the Name of a fixed Star.

*Aliquot Parts*, are parts that are contained a certain Number of Times in their whole; as 2 is contained thrice in 6.

*Aliquant Part*, is a part contained in its whole, a certain Number of Times, leaving a Remainder over and above, as 2 in 7.

*Alligation*, is a Rule in Arithmetick, which teaches to join together several things of unequal Prices, to find how much of each must be taken according to the Tenor of the Question.

*Almagest*, the Name of an excellent Treatise of the Sphere, written by *Ptolemy*, and also of another Astronomical one, written by *F. Riccioli*.

*Almanack* or *Calendar*, is a Political Distribution of Time, accommodated to humane Uses, and taken from the Motions of the Celestial Bodies, whence those Annual Books, wherein the Days of the Month, Eclipses, Festivals, &c. are set down, are so called.

*Almicantarahs*, so called by the *Arabians*, are Circles of Altitude parallel to the Horizon, whereof the common Pole is by Consequence the Zenith.

*Altitude*, of the Sun, Moon or Stars, is their height above the Horizon.

— of a Geometrical Figure is the perpendicular distance between its Vertex or Top and its base.

— of the Pole: See *Elevation*.

*Amain* (a Sea-word) used by a Man of War to his Enemy, and signifies *Yield*. Strike *amain*, that is, lower your Topsails.

*Ambligonum* (Triangle) is that which hath one obtuse Angle.

*America*, one of the four Parts of the World, so called, from the Name of the first supposed Discoverer of it, who was a Florentine, tho' indeed *Christopher Columbus* a Genoese discover'd it first of all.

*Amphisbii*, People who cast Shad.

Shadows two ways, or whose Shadows sometimes are cast towards the Arctick, sometimes towards the Antarctic Pole: Such are those who inhabit the Torrid Zone.

*Amplitude*, is an Arch of the Horizon comprehended between the rising and setting, (and accordingly called oriental or occidental Amplitude) of the Sun, Moon, or any Star, and the East and West-point of the Horizon. The oriental and occidental Amplitude is called Septentrional when it is in the North, and Meridional, when it is in the South-quarter of the Horizon. The oriental Amplitude of the Sun is commonly called its rising, and the occidental its setting.

*Analemma*, an Orthographical Projection of the Sphere: See, Projection.

*Analogy*, or Geometrical Proportion, is a Similitude of Geometrical Reasons. Thus these 4 Numbers, 2, 3, 4, 6, are in Geometrical Proportion, because the Geometrical Reason of 2 to 3, is like (or the same with) that of 4 to 6, each being Subsequalteran.

*Analysis*, which signifies Resolution, and may also be called the Method of Invention, is the Art of discovering the Truth or Falshood,

Possibility or Impossibility of a Proposition, and proceeds in a Retrograde way to *Synthesis* or *Composition*, viz. by supposing the Question to be already done; and then examining the Consequences that follow from it, till you arrive to some known clear and evident Truth, or Impossibility of the Proposition in hand, which may be afterwards demonstrated synthetically by resuming backwards the same steps you proceeded by before. This term is very often used for *Algebra* it self, which is nothing else but a general Analysis of the pure Mathe-maticks.

*Anchor*, is an iron Instrument belonging to a Ship, to stop or stay her, which being so Universally known needs no farther description.

*Anchor apeak*, (a Sea-term) signifies that the Anchor is right under the Hawse, (or Hole) through which the Cable belonging to the Anchor runs out.

*Anchor is a Cock-bell*, that is, hangs up and down by the Ship's side.

*The Anchor is foul*, that is, the Cable is got about the Fluke.

*Angle Plain*, is the distance or opening of two lines touching each other, so as not to

to compose one right line; or it is an indefinite Space terminated by the meeting of two lines which intersect one another on a plane; and may be either Right-lined, curvilineal or mixed.

*A Right-lined Angle*, is that which is made by the meeting or intersection of two right lines.

*Angle mixed or mixtilinear*, is that which is made by the intersection of a Right-line, and a Curve or crooked Line.

*Curvilinear*, is that which is made by the intersection of two Curve-lines.

*Spherical*, is an Angle made by the meeting or intersection of two Arches of great Circles, which intersect one another on the Surface of the Sphere.

*Angles*, whether plain or spherical, may be either oblique, right, acute or obtuse.

*Angle Right*, is when one line falls perpendicularly on another; it consists of 90 Degrees or one quarter of a Circle: A Circle being commonly divided by Mathematicians into 360 equal Parts, called Degrees.

*Acute*, is any Angle that is less than a Right one.

*Obtuse*, is any Angle that is greater than a Right one, or that consists of more than 90 Degrees.

*Solid*, is the meeting of three or more Planes, which intersect one another, and meet all in one Point.

*Angle of Incidence*, is a Catoptrical-term, and is that which a Ray of Light falling on any Body forms with any Tangent-line of that Body, which is next the lucid Body.

*Angle of Reflection*, is that which is made by the reflected Ray at the Point of Reflection with the other Part of the Tangent-line of the said Body.

*Angle of Refraction*, is that which is made by the Ray of Incidence prolonged thro' another Medium (as out of the Air into the Water) and the Ray of Refraction; or the same Ray consider'd as deviating from a Right-line, or as it were broken, which the word signifies.

*Polygon*, or many sided Figure, is that which is formed by the meeting of any two of the sides of that Polygon next one another.

*Anomaly*, Irregularity or Inequality in Motion.

*Antarctic-Pole*, the South-Pole, and also the Name of a Circle described twenty three Degrees and a half from it, called the Antarctic-Circle.

*Antecedent* of a Reason, is the first Term of Comparison in a Proportion, or that which is compared to another; thus in the Reason of 2 to 3, 2 is the Antecedent, and 3 the Consequent of that Reason.

*Antipodes*, are the Inhabitants of a Country diametrically opposite to us. Whence it will follow that they are in Parallels of Latitude equally distant from the Equator, and in different Halves of the same Meridian.

*Antaei*, or those who inhabit just contrary one to another, are in the same Semi-circle of the Meridian; but in diverse Parallels equally distant from the Equator, whence it follows that they have the same Latitude and Longitude, but on different sides of the Equator.

*Apparent*, the apparent or visible Place of any Star, or Planet, is that Place of the Heaven it seems to be in by the Right-line that proceeds to it from the Eye.

*Aphelion*, ( in the Copernican System ) is that Point in which the Earth or any Planet is farthest distant from the Sun; when nearest it's called its Perihelion.

*Apogæum*, is when any Planet is in its greatest di-

stance from the Earth; as when it is nearest to it, it is said to be in its Perigæum.

*Apomecometry*, the Art of measuring things at a distance.

*Apotome*, is an irrational Remainder or Residual, when from a rational Line  $a$ , another is cut off as  $b$ ; that is only commensurable in Power, then  $a - \sqrt{b}$ , is an Apotome.

*Approximation*, is a continual approaching nearer and nearer to Equality, a Term made use of in the Doctrine of infinite Series in Geometry, as e. g.  $2 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8}$ , &c. approaches continually nearer to 3, *ad infinitum*.

*Aquarius*, one of the 12 Signs in the Zodiack, in order the 11th. commonly noted thus .

*Aquito*, the North-wind.

*Arch*, a part of a Curve-line.

*Aræos*, [the Bear] a Constellation in the Northern-part of Heaven: Whence

*Aræick-Circle*, is a Circle twenty three Degrees and a half from the said Pole.

*Area*, the Surface of any Figure.

*Aries*, [the Ram] one of the 12 Signs of the Zodiack, in order the first.

*Artificial Numbers*: See, Sines, Tangents, and Secants.

*Archipelagus*, is a Part of the Sea which contains several small Isles one near another, and consequently several little Seas denominated from those Isles, as the *Egean-Sea*, which in a little room incloses several Seas of different Names, derived from the respective Isles therein; also the Sea which washes the *Philippine Islands*, is called the great *Archipelagus of St. Lazarus*.

*Architecture*, is the Art of Building, and is commonly divided into Civil and Military. The first relates to private Houses, and publick Structures, as Churches, &c. the latter is called *Fortification*, q. v.

*Architrave*, is the main Beam in a Building.

*Arithmetick*, the Art of Numbering, a principal Part of the *Mathematicks*, the Object whereof is discreet Quantity.

*Aimillary Sphere*, a hollow Sphere made of Circles, or rather Cylindrical Rings.

*Ascensions and Descensions of Signs*, are Arches of the Equator, which (Co-ascend) rise or set with such a Sign or part of the Zodiack, or any Planet therein. These Ascensions and Descensions are either Right or Oblique.

— *The Right Ascension of*

*a Sign*, is the Arch of the Equator, which rises with the Sign on the Horizon of a right Sphere: Or it is the time a Sign is rising on the Horizon of a right Sphere.

— *The Oblique Ascension of a Sign*, is the Arch of the Equator, which rises or sets obliquely with that Sign on the Horizon of an oblique Sphere.

*Asci*, (or those that have no shadows) having the Sun in their Zenith, are such as inhabit the Torrid Zone.

*Asia*, one of the four parts of the World, called by Sailors the *Levant*, as being the most oriental of the three parts of the Continent.

*Asterism*, a Constellation, or parcel of fixed Stars.

*Astrolabe*, a Mathematical Instrument to observe the Sun or Stars with.

*Astronomy*, is a Science that contemplates the Motions, Magnitudes and Distances of the Celestial Bodies.

*Astrology*, the Professors of it pretend it to be a Science of future Events, from the Motions and imaginary Qualities of the Stars, as the remote Causes of all sublunary Effects: But being a Science exploded by the most judicious and learned Men, we have therefore thought it needless to explain any of its Terms.

*Asymmetry*, is also called Incommensurability and, is when between two Quantities there is no common Measure, as between the Side and Diagonal of a Square, which *Euclid* in his 10th. Element demonstrates to be incommensurable. In Numbers, surd Roots as  $\sqrt{2}$ , &c. are incommensurable to rational Numbers.

*Asymptote*, is a Right-line ( in Conick Sections belonging to an Hyperbola ) which approaches to a Curve-line continually nearer and nearer; but, untill produced *ad infinitum*, ( which can never be ) will never touch it. Two Parabola's may be drawn Asymptotick to one another, moreover there may be Asymptotes to infinite Curves.

*Atmosphere*, is the hollow Sphere of Air ( wherein Clouds arise ) which environs the Earth. The Planets have likewise Atmospheres which inclose them.

*Auge*: See *Apogamum*.

*Aurora*, the Morning, Twilight, which begins to appear when the Sun approaches within 18 Degrees of the Horizon, and ends when it rises above it.

*Austral*, (Southern) Signs, are the six last Signs of the Zodiack, viz.  $\Sigma$ ,  $\Pi$ ,  $\lambda$ ,  $\nu\sigma$ ,  $\pi$ , and  $\chi$ , and so called be-

cause they are on the South-side of the Equinoctial.

*Automa*, a self-moving Engine, as watches, &c.

*Autumn*, one of the four Quarters of the Year, beginning when the Sun enters  $\Sigma$ . Harvest or the Fall of the Leaf.

*Awning*, [ a Sea-term ] is the Boat-sail, or some piece of an old Sail brought over the Yard and Stay, and boomed out with the Boat-hook, and so spread over head, and is used as well ashore, as aboard, especially in hot Countries, to keep Men from the Extremity of heat or wet, which is often infectious.

*Axis of a Figure*, is a straight line, conceived to proceed from the Vertex or Top to the base: Or in a Circle or Sphere from one side to another, through the Center, and is the same as the Diameter.

— *Of an Hyperbola, Ellipsis, &c.* Conjugate or Transverse, q. v.

— *Of the World*, is an Imaginary-line conceived to extend from one Pole to another.

— *Of the Zodiack*, is also conceived to pass through the Earth, and to be terminated in the Poles of the Zodiack. v. Pole.

— *Of Rotation*, or Circum-

evolution, is an Imaginary-line about which any plain Figure is conceived to be turned to make a solid: Thus a Sphere is conceived to be made by the Rotation of a Semi-circle about its Diameter, and a Cone by that of a Right-angled Triangle about its Perpendicular.

*Axioms*, are common or self-evident Principles, which all Men ( in their right Senses ) admit as such; as, *viz.* That the whole is greater than its part, and such like.

*Azores*, are certain Islands in the North-latitude of 40 Degrees, whence some count the Longitude, or Place where their first Meridian begins.

*B*ackstaff, an Instrument used by Sea-men for observing the height of the Sun with ones Back towards it.

*Baculometry*, the Measuring of Distances by two or more Staves.

*Balance*, in the Mechanics, is one of the six Principles, or simple Machines, and may be conceived as an inflexible Right-line, or more grossly like a Beam suspended by a Point in the Middle.

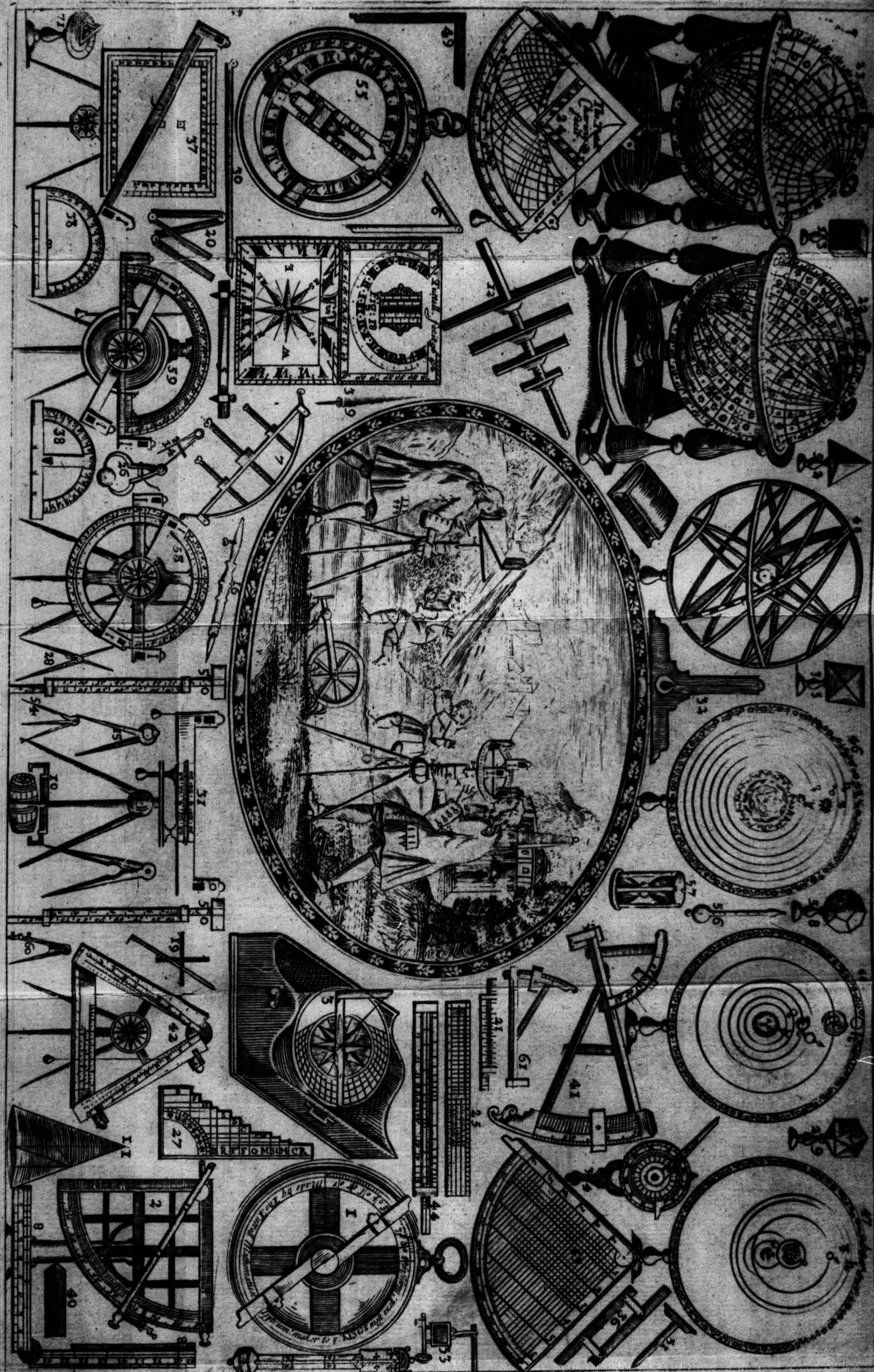
They are numbered among the first Principles of Demonstration. *Azimuths*, are great vertical Circles which intersect one another in the Zenith and Nadir; the Planes whereof are consequently perpendicular to that of the Horizon.

*Azores*, are certain Islands in the North-latitude of 40 Degrees, whence some count the Longitude, or Place where their first Meridian begins.

*B*ackstaff, an Instrument used by Sea-men for observing the height of the Sun with ones Back towards it.

*B*alance, to fad Water out of the Ship's Hold with Buckets.

*B*allast, is any solid heavy Matter, as Iron, Lead, &c. but most commonly gravel, which is laid into the Ships Hold to make



make her sail upright, and keep her from over-setting.

— *Trench the Ballast*, is to divide or separate it.

— *Shoots*, that is, it runs over from one side to another.

*Ballista* and *Ballistarii*, were Engines and Engineers the Ancients made use of to fling great Stones with.

*Barometer*, is an Instrument made use of to find the Weight of the Air, and thence to predict fair or foul Weather, &c.

*Bark*, a small sort of Ship or Vessel that has but one Deck.

*Base* or *Basis*, the Bottom of any Figure, or other thing.

*Bastion*, a Term in Fortification anciently called Bulwark, and consists of two Faces, two Flanks and a Gorge, and is made at the Angles of Forts.

*Battalion*, is a Body of Infantry of 7 or 800 Men, whereof two thirds are commonly Musqueteers posted on the Wings, and the rest Pike-men in the Middle; but the Number is not always alike, and so cannot be certainly determined.

*Battery*, is a Post where the Cannon are planted against the Enemy.

*Bay*, in Geography is an Arm of the Sea coming up

into the Land, terminating in a Nook, and is greater than a Creek, and less than a Gulph; or it is a sort of a little Gulph bigger within than at the Entrance, as the Bay of Cadiz.

*Beake-head*, is that part without a Ship before the Fore-castle, supported by the main Knee, fastned into the Stem, all painted and carved as the Stern, and of good use, as well for the Ornament of the Ship, as also a Place for the Men to ease themselves in.

— *Bear up*, a Term used in condign a Ship, when they would have her sail more before the Wind.

*Bear up round*, put her right before the Wind.

*Bear in with the Land*, to sail towards it.

— *To bear in*, that is to sail before, or with a Wind into a Harbour or Channel.

— *A Piece of Ordnance does come to bear*, that is, lies right with the Mark.

*Bearing*, the Point of the Compass that one Place bears or stands off from another. It is used in Navigation.

*Bear*, the Name of two Constellations in the Heavens, called the Greater and the Less Bear, in the Tail whereof is the Polar Star, so called, because it is very near

near the North-Pole, being only two Degrees and a half distant from it, whence it appears to the Eye as if exactly in the same Place.

*Belage*, to make fast any running Rope.

*Bend a Cable*, is to make it fast.

*Bight*, any part of a Rope between the Ends.

*Billage*: a Ship Billage is the breadth of the Floor when she lies aground, and Billage-water is that that cannot come to the Pump. They say also a Ship is

*Bilged*, when she has struck off some of her Timber on a Rock or Anchor, and springs a Leak.

*Binomial*, a Term in *Algebra*, signifying a Quantity composed of two Parts, as  $a + b$  where note that the Sign + signifies added to, or addition.

*Birth*, a convenient place to moor a Ship in.

*Bisect*, to cut or divide any thing, as a Line or Angle into two equal Parts.

*Bissextile*, *Leap-year*, (so called, because then they paid twice the sixth Calends of March) when once in four Years a whole Day is added, to make up the odd 6 Hours, whereby the Course of the Sun yearly exceeds

365 Days, being inserted or put in next after the 24th. of February.

*Bittake*, (n) that where-on the Compass stands.

*Bitts*, (n) two main square Pieces of Timber, to which the Cables are fastned when the Ship rides at Anchor.

*Bitter*, a turn of a Cable about the Bitts.

*Blocks*: on Ship-board Pul- lies are called by that Name.

*Board and board*, a Term used when two Ships come so near as to touch one another.

*Body*, in Geometry is that which hath three Dimensions, viz. Length, Breadth, and Thickness.

— Regular is that which has all the Angles and Sides, and all the Planes that compose its Surface like and equal. There are only five sorts, viz. The *Tetraedrum*, *Hexaedrum*, *Octaedrum*, *Dodecaedrum* and *Icosaedrum*, and are as follow.

— The *Tetraedrum* is a Pyramid terminated by four equal and equilateral Triangles.

— The *Hexaedrum* or Cube, is a parallelepiped terminated by six equal Squares.

— The *Octaedrum* is a regular Body terminated by eight equal and equilateral Triangles.

— The *Dodecaedrum* is a solid

Solid comprehended under or terminated by twelve equal and equilateral Pentagons.

— The *Icosaedrum* is a solid contained under twenty equal and equilateral Triangles.

— *Irregular*, is a solid which is not terminated by equal and like Surfaces.

*Bombs*, are hollow Balls of Iron which are charged with Powder, and sometimes with Nails and Pieces of Iron, &c. to be shot into besieged Towns, some of them are of 38 Inches, and 2 Foot Diameter.

*Bombard*, is to shoo those Bombs out of short Pieces, called Mortars, into Towns, &c.

*Boam*, a long Pole used on Ship-board to spread out the Glew of the studding Sail.

*Bonnet*, aboard a Ship, an Addition to another Sail; when they fasten it on they say, *lace on the Bonnet*; when they take it off, they say, *shake off the Bonnet*; it is very rarely fastened to any other except the Mizen, Main-Fore-sail, and Sprit-sail, and those Sails are called Cour-

ses, as Main-course and Bonnet, not Main-sail and Bonnet.

*Bootes*, the Name of a Constellation in the Heavens.

*Boreal*, of or belonging to the North.

*Bosphorus*, is a narrow Streight or Neck of the Sea which separates two Continents, and through which two Seas have Communication.

*Box and Needle*, an Instrument used in surveying Land: And finding the Situation of any side by the pointing of one End of its Needle towards the North.

*Brachiolum*, a Member of an Instrument sometimes used upon Astrolabes, and other Projections of the Sphere. It is by English Writers sometimes called a Creeping Index.

*Bulk-head*, (aboard a Ship) is a Cieling or Partition of Boards thwart the Ship, as the Gun-room, the great Cabbin, the Bread-room, the Quarter-deck or any other such Division.

## C A

**C**alendar. V. Almanack. After the first, which was of *Romulus*, it was first corrected under *Numa Pompilius*, and bore his Name; it was further reformed by *Julius Cesar*, and from him called the *Julian Calendar*, which obtains still among us: Lastly, it was corrected by Pope *Gregory the XIIIth*; and thence called the *Gregorian Calendar*, which is now in Use in the *Roman Catholick Countries*, and else-where, and is what we call the *New Style*.

*Calends*, were first placed in these Calendars, and whence the Calendar seems to have taken its Name. They were the first Days of every Month; after which followed the *Nones*, *Ides*, *Epacts*, and *Dominical Letters*, which see under their respective Letters.

*Camp*, a large and spacious Piece of Ground fit for an Army to encamp on.

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*August*, whence those Days are called,

*Canicular*, or the *Dog-days*.

*Canon*, [a Rule.] The Tables of Artificial Sines, Tangents, Secants, are so called; or in Algebra it is a general Rule for resolving a Problem, &c.

*Cannon*, is also a Piece of Artillery about 10 Foot long, and six Inches bore.

*Capacity*, in Stereometry, is the same as the solid Contents of any Body, q. v.

*Cape*, or *Promontory*, is any Mountain or other considerably high place, which runs out into the Sea; as the Cape of good hope.

*Capitel*, or *Chapitel*, in Architecture, the Top of Pillars, and are different according to the different Orders.

*Capricorn*, [the Goat] one of the Signs of the Zodiac, the 10th. in our Order of counting, and thus characterized (V8.)

*Captain* in a Ship, is a great Piece of Wood, that stands upright upon the Deck, abaft the main Mast, the Foot standing in a step upon the lower Deck, and is in the Nature of a Wind-lace, to weigh up the Anchors, Sails, Top-masts, Ordnance, or any thing else, &c.

*Carcasse*, an Iron-case about the bigness of a Bomb

covered with pitch'd Cloath and Hemp, and filled with several sorts of Materials for firing, Gun-powder, &c.

*Carene*, is to refit or mend a Ship.

*Carling-knees* in a Ship, are Timbers that come thwart the Ship, from the sides of the Hatches way, betwixt the two Masts, and bear up the Deck on both sides.

*Carriages*, for Pieces of Ordnance, are the wooden Frames on which they are carried. To make them, 1. measure the length of the Cylinder of the Gun; once and a half that length should the Carriage be. 2. Measure the Diameter of the bore of the Piece; four of those Diameters measure the Depth of the Planks at the fore-end: in the Middle, three and a half: and in thickness one Diameter. 3. The Wheels should be one half the length of the Piece in height.

*Cartridges*, are hollow Cases of Paper made in form of Cylinders to put in the Powder for Charges of Guns.

*Cascade*, is a fall of Water, whether natural or artificial; the artificial ones are made by steps or gradations, where Rivulets run through, or may be brought

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to do so, as in some Gentlemen's Gardens, &c.

*Cassiopeia*, a Constellation in the North-part of the Heavens.

*Castor and Pollux*, a Constellation, the same as Gemini, q. v.

— Also Fires (or Meteors) which happen sometimes at Sea, and appear to Mariners about the Masts or Yards of the Ship, and are so called when double, or when two appear.

*Catapultes*, were Engines wherewith the Ancients used to cast Javelins of 12 or 14 Foot long.

*Cataract*, a Fall of Water which is natural and makes a great noise.

*Calculus* in a Triangle, is the Perpendicular.

— in Catoptricks, is a line drawn from the Point of Reflection perpendicular to the Plane of the Speculum: As CG, which bisects the Angle FCD. Pl. I. Nu. 1.

*Catoptricks*, is a Science which teaches how Objects may be seen by Reflection, and explains the Reasons of it.

*Caulking* in a Ship, is beating *Oakum* into every Seam, or betwixt Plank and Plank, which is done with a

*Caulking-Iron*, and a Mallet, which is a Hammer of Wood, and an Iron-Chisel,

well-payed or dawbed over with hot Pitch, which makes her more light than it is possible to do by joyning Plank to Plank.

Center of a Circle, and also of a Sphere, is the middle Point from whence all the lines drawn to the Circumference are equal.

— of a Regular Polygon, is the same as the Center of a Circle inscribed in it, so as to touch all its sides.

— of an Ellipse or Oval, is the Point where the two Diameters intersect one another.

— of an Hyperbola, is a Point in the Middle of the transverse Ax. Whence it follows that it is without the Hyperbola, and common to the two opposite Sections.

— of Magnitude of a Body, is a Point, which is as equally remote as possible from its Extremities.

— of Gravity, is a Point whence a Body being suspended all the parts of it are in *Aequilibrio* one to another.

— of heavy Bodies here on the Earth, is the Center of the Earth, whither all heavy Bodies on its Surface, endeavour to descend.

— of Motion of a Body, is a Point about which, a Body being fastned (or any ways

re-

retain'd) to it, may or does move, as the Middle of a Balance suspended, &c.

*Centesim*, the hundredth part of any Integer.

*Chain-shot*, is two Bullets with a Chain betwixt them; some are contrived round as a Ball; yet will expand in flying, their full open length. Their use is, when shot out of a Gun at Sea, to shoot down Masts, Yards, Shrouds, near the Sails, or spoil any thing that is above Deck.

*Charts*, [Papers] Descriptions, or Draughts of any Place; as,

— *Geographick* when general, is a Description of the whole Earth upon a Plane, and for that reason is sometimes called a *Planisphere*, but commonly a Map of the World; and in particular,

*Chorographick*, or Descriptions of a whole Region, whence also absolutely the Art is called *Chorography*.

— *Topographick*, is a Description of a little part of the Earth without regard to its relative Situation; as of *London*, *Amsterdam*, &c.

— *Hydrographick*, or *Marine*, are Charts which not only contain part of the Land and Sea, according to the Longitude and Latitude of each Place, but also the Points of the Compas in several parts of the Chart,

— *Selenographick*, are Charts of the Moons Parts, Appearances and Spots.

— *Heliographick*, are Descriptions of the Sun's Body, and *Macula* or Spots.

*Chase at Sea*: to give chase to a Ship, is to follow and fetch her up, or come up with her.

*Chiliads*, (Thousands) are Tables of Logarithms so called.

*Chord*, is a line in a Circle connecting the two Ends of any Arch.

*Chronology*, is the Art of computing Times by the heavenly Motions, and keeping an Account of things and Transactions of the World, in relation to compose Histories of them.

*Chrystalline Heavens* were supposed two, the first served to explain the slow Motion of the fixed Stars, which caused them to move one Degree in 70 Years towards the East, the second served to explain a Motion, some call'd the Motion of *Trepidation* or *Libration*, by which the Astronomers imagined the Sphere to be carried from one Pole to the other, &c.

*Circle*, is a plane Figure comprehended under one only line, called its

*Circumference*, whence all the lines drawn to its Cen-

er are equal to one another.

*Circumferentor*, the Name of an Instrument for surveying Land.

*Cissoid*: See the End of this Letter. Plat. I. Num. 2.

*Citadelle*, is a Fort of 4 or 5 Bastions, and sometimes of six, which is built somewhere near a City, that it may command it, in Case of Rebellion of the Inhabitants, for which reason the City is not fortified on that part, which is against the Citadel, but the Citadel is against the City. A Pentagon is the most ordinary and most convenient Form for Citadels; a Square being too weak, and an Hexagon too big.

*Civil-year*, ( so called in Contra-distinction to the Natural ) is the legal Year used in civil Cases between Man and Man, as in Contracts, &c.

*Climate*, a Part or Portion of the Earth contained between two Circles parallel to the  $\text{\AA}$ quator; and where there is half an Hours difference in the longest Day of the Summer. Each Climate is moreover divided into two half Climates by a Parallel Circle; each half Climate is called a Parallel, and they vary a quarter of an

Hour from one another in the longest Days.

*Co-efficient*, is the known Quantity that is multiplied into any of the unknown Terms of the Equation.

*Colures*, are two great Circles which intersect one another at Right-angles in the Poles of the World, and divide the Zodiack, and so the whole Globe into four equal Parts, and denote on the Ecliptick the four Cardinal-points, or Seasons of the Year.

— The one is called the Colurus of the Solstices, because it passes through the two Solstitial Points, or first Degrees of Cancer and Capricorn.

— The other is called the Colurus of the Equinoxes, because it marks the Equinoctial Points on the Ecliptick, or the beginning of Aries and Libra.

*Column*, [ Pillars ] in Architecture, they are of different Proportions, as to length and thickness, according to the different Orders: See *Orders*.

*Combination*, is the Art of finding how many different ways, a certain given Number of things may be vary'd or taken by one and one, two and two, three and three, &c.

*Comets*, are what are commonly

monly called blazing Stars. The Ancients, especially *Aristotle* and his Followers supposed them to be Meteors or Exhalations, set on fire in the highest Region of the Air: The Modern Astronomers have found them to be above the Orbit of the Moon, but yet to descend so low as to move in the Regions of the Planets; it is not improbable but that they may be a sort of very Eccentrical Planets, and move periodically about the Sun; the return whereof some have pretended to predict, but have lived to see themselves confuted.

*Commensurable*: Quantities are said to be commensurable between which, or to measure which, a common Measure may be found; as all Integer Numbers may be measured by Unity.

*Compasses*, an Instrument consisting of two Legs used in practical Geometry to describe Figures with, especially Circles.

— Also other wooden or brass Instruments, in form of a Ruler, with a joint to shut and open in the Middle, and on the Legs are cut lines of equal Parts, Chords, &c. much more easie to be understood by sight, than any Description.

— Also the Sea Chart

whereon the four Cardinal Winds, and their Subdivisions are engraven, and used by Sea-men to steer by, by help of a Magnetick Needle, whose ends being touch'd by a Load-stone always stand near the North and South tho' in different Parts of the World, with different variations from those Points.

*Complement*, [a filling up] of an Arch or Angle, is what that Arch or Angle wants of 90 Degrees, or that Part by which it exceeds 90 Degrees. Thus the Complement of an Arch or Angle of 40 Degrees is 50 Degrees; and of 120 Degrees is 60 Degrees to make a Semi-circle.

— of a Parallelogram, are the two small Parallelograms through which the Diagonal does not pass.

— of the Course [ in Navigation ] is the Number of Points the Course wants of 90 Degrees or eight Points, viz. of a quarter of the Compass.

— of the Curtain [ in Fortification ] is that part of the Curtain which ( being wanting ) is the Demi-gorge.

*Composition*, a Method of Demonstration which proceeds in a retrograde Course to Analysis or Resolution, and demonstrates from self-evident

dent Principles by Steps or Propositions till you come to the Conclusion, or last thing to be demonstrated, and so gives a clear and distinct knowledge of the thing sought. Euclid's Elements are demonstrated after this way.

— of Reasons, is the comparing the Antecedent and Consequent taken together to the Consequent alone in two equal Reasons; as if there be the same Proportion of 2 to 3, as of 4 to 6, you conclude by Composition that there is the same Reason of 5 to 3, as of 10 to 6.

*Composite Order*, in Architecture, which is also called Italick and Roman, because it was the Invention of the Ancient Romans, is called so because it is composed of the other 4 Orders, viz. Tuscan, Dorick, Ionick and Corinthian. The finest is composed only of the Ionick and Corinthian.

*Concave, Hollow, and Convexity*, is the Hollowness of any thing.

*Concentrick*, Figures that have the same common Center.

*Conchoid*: See the End of this Letter. Plat. I. Num. 3.

*Cond or Cun*, ( a-Ship-board ) is to direct or guide;

to *cun* a Ship is to direct the Person at Helm how to steer her.

*Cone*, is a solid Body which may be conceived to be made by the Motion of a line conceived as fixed at one End, and describing a Circle with the other, and may be either Right or Scalene.

— *Right*, is when its Ax is perpendicular to its base, and then its sides are equal.

— *Scalene*, is when its Ax is inclined to its base; and then its sides are unequal.

*Conical Shadow of the Earth*, is that Shadow which the Earth casts in the Air, on that side, or from that Hemisphere which is opposite to the Sun, and always makes Night.

*Conjunction of two Planets*, is when one passes under the other, so as to make one right line in respect of any part of the Earth, and may be apparent or true.

— *Apparent* when the right line drawn through the Centers of the 2 Planets does not pass through the Center of the Earth, and

— *True*, when that right line being prolonged passes also through the Center of the Earth.

*Conoid*, is a solid produced by

by the Circumvolution of any Section of the Cone about its Ax, and may be either

— *Parabolical*, when it is produced by the Section called a *Parabola* about its Ax, or

— *Hyperbolical*, when made by an *Hyperbola*, or lastly

— *Elliptical*, when made by an *Ellipsis*, and then is called more commonly a *Spheroid*, q. v.

*Consequent* of a Reason, is the Term to which the Antecedent is compared; as in the Reason or Proportion of 2 to 3, 3 is the Consequent to which the Antecedent 2 is compared.

*Constellation*, or *Asterism*, is a Company of fixed Stars, imagined to represent the Image of some thing, and called commonly by the Name of that thing. There are 21 Northern, and 12 Southern ones.

*Content*, [ in solid Geometry ] is the Measure of any solid Figure, viz. in Cubick-inches or Feet, &c.

*Continent*, or *Terra Firma*, is a great extent of land, which comprehends several Regions and Kingdoms, and which is not interrupted or separated by Seas.

*Conversion of Reason*, is the Comparison of the Ante-

cedent to the Difference of the Antecedent, and the Consequent in two equal Reasons; as if there is the same Reason of 2 to 3, as of 8 to 12, we conclude there is also the same Reason of 2 to 1, as of 8 to 4.

*Convexity*, any Protuberancy or Swelling out of any thing, as Glasses are said to be *Convex* when they are thicker in the Middle than at the Edges.

*Copernican System* [ from *Copernicus* the Inventor, or rather Reviver of it ] is that which places the Sun in the Center of the Universe (or at least of our part of it) and supposes the Planets, and among the rest the Earth, to move round about it.

*Cordage* of a Ship, is all the Ropes belonging to the Masts and Yards.

*Corinthian Order*, [ in Architecture ] is where the height of the Columns or Pillars contain nine of their Diameters. They were first made of this Proportion at *Corinth*, whence they are so named.

*Corollary*, a Consequence drawn from what has been advanced or proposed: as if from this, viz. That a *Triangle* which has two equal sides has also two Angles equal you should draw this Consequence: That a *Triangle* which

which has the three sides equal has also its three Angles equal.

*Cortin*, the Wall or Distance between the Flanks of two Bastions.

*Co-secant*, } See Figure, &c.  
*Co-sine*, } where, &c.  
*Co-tangent*, } Plat. I. Num. 4.

*Cosmical*, Stars are said to rise *Cosmically*, when they rise with the Sun ; and to set *Cosmically*, when they set when the Sun rises.

*Cosmography*, according to its Etymology, is a Description of the World, or of the Universe: Also it is a Mathematical Science which teaches the Structure of the Universe, and examines its Figure, Magnitude, Number and Disposition of its parts. Their Distances and Motions, &c.

*Cosse* and *Cossie*, the old word for *Algebra*, which *Cosa* in Italian signifies.

*Counterscarp*, [ in Fortification ] is that side of the Ditch which is next the Camp.

*Course*, [ in Navigation ] is the Ship's way.

*Cradle*, ( belonging to a Ship ) is a Frame of Timber, made along a Ship, or the side of a Galley by her Eillage for the more Ease and Safety in launching, much

used in Turkey, Spain, and Italy.

*Crepuseulum*, Twilight either Morning or Evening.

*Croisiers*, four Stars in form of a Cross, which serve to shew those that sail in the Southern Hemisphere, the Antartick Pole.

*Cross-staff*, an Instrument Sea-men use to observe the height of the Sun and Stars with.

*Cubbridge-head*, aboard a Ship, &c. is the cieling or boards which close the Forecastle, and the half Deck, wherein are placed Murtherers, and abaft Falcons, Falconets, or Robinets to clear the Decks fore and aft, as also on the Ship's sides to defend the Ship, and offend an Enemy.

*Cube*, is a Parallelepiped terminated by six equal Squares ; like a Dice.

*Cube of a Number*, is a Number twice multiplied by it self, as 27 is the Cube of 3, or the third Power of any Number.

*Cubo-Cube*, the sixth Power of any Number.

*Culvering*, a Piece of Ordnance whose Diameter is 5 Inches bore, 12 Feet long, weighing about 4000 l. carries a Shot 4 Inches 3 quart. Diam. weighing 14 l. 9. Ou.

*Cuneus*, a Triangular Prism, or a Wedge.

*Curvature, Crookedness.*

*Curve, Crooked-lined as a Circle, Parabola, &c.*

*Curvilinear, Crooked-lin'd.*

*Circle, [ in downright English Circle ]* is a continual Revolution of certain Numbers, which successively go on without any Interruption, from the first to the last, and then return again to the first, and so circulate perpetually. There are three principal Cycles in the Calendar, *viz.* the *Solar*, the *Lunar*, or the *Golden Number*, and the *Cycle of Indiction*.

*Cycle of the Sun, or Solar Cycle*, is a Revolution of 28 Years for finding out the Dominical Letters, which then return all in the same Order as before.

*Cycle Lunary, or Lunar Cycle, or Golden Number*, is a Period or Revolution of 19 Years, wherefore it is sometimes called *Enneadecaterides*, after the Expiration of which all the Lunations return to their former Place in the Calendar, *i. e.* the New Moons happen in the same Months and Days of the Month.

*Cycle of Indiction, or Indiction*, is a Revolution of three Lustrums, or fifteen Years, after which those who used

it began it again. This is more ancient than the precedent ones, and has nothing to do with the heavenly Motions, being established by *Constantine*, who substituted them in the room of the Olympiads: They were so called according to some Authors, because they denoted the Year that Tribute was to be paid to the Republick.

*Cycloid*: See the End of this Letter. *Plat. I. Num. 5.*

*Cylinder*, a solid Body which may be conceived to be made by the Rotation of a Parallelogram about one of its sides.

*Cynosura*, a Constellation otherwise called *Ursa Minor*, or the little Bear, in the Tail of which is the Polar Star.

*Cypher, or a Nought* thus noted (o;) which put before a Figure signifies nothing (except in Decimal Arithmetick where it augments, being put before in the same Proportion as when put after in Integers) but after a Figure it increases it by ten, and so onwards in Decuple Proportion, or by tens, *Ad Infinitum.*

## D A

## D A

**D**ata, ( a Term most commonly used in Analyticks ) are things or quantities given or known in order to find out thereby other things or quantities unknown or sought.

**Dead-water**, the Eddy-water at Stern of a Ship.

**Decimal Arithmetick**, or the Arithmetick of Decimal Fractions, is that which treats of Fractions, or parts of Integers reduced to tenths, hundreds, thousands, &c. of their respective Integers.

**Declination** of the Sun or any Star, is its Distance or Digression from the Equator, towards either of the Poles of the World; and is according to that Digression called either North or South Declination.

**True**, is the Distance of the true Place of a Planet from the Equator.

**Apparent**, is the Distance of the apparent place of a Planet from the Equator.

—of a Wall or Plane for Dials, is an Arch of the Horizon comprehended between the Plane, and the first Vertical. *V. Vertical.*

**Deferent**, an imaginary Circle or Orb in Astronomy (in the Ptolemaick System) that they fancy'd, as it were, to carry about the Body of the Planet.

**Definition**, [ in the Mathematics ] is the Explication of the Words or Terms made use of, to explain the thing treated of.

**Degree**, is the 360th part of a Circle, it is subdivided into 60 parts called Minutes, and each of them again into 60 parts more called Seconds, and so into Thirds, &c.

**Parodick**, is the Index or Exponent of any Power in *Algebra* ( and thence in Numbers ) as 1 is the Exponent or Parodick Degree of the Root, 2 of the Square, 3 of the Cube, &c.

*Demicannon*, the Name of a great Gun, the ordinary ones are 6 and a half Inches bore, 5600 l. Weight, some 10, some 11 Feet long, and carries a Shot of 32 Pound Weight.

*Demi-culvering*, also a great Gun, the ordinary sort are 4 Inches and a half bore, 2700 Weight, 10 Foot long, carries a shot of 9 Pound.

*Demigorge*, [ in Fortification ] is half of the Gorge, or the line comprehended between the End of the Cor-tin and Center of the Ba-stion.

*Demonstration*, is a Chain of Arguments depending one on the other, and founded primarily on first or self-evident Principles, ending in the invincible Proof of a thing to be demonstrated, as the Conclusion.

*Denominator* of a Fraction, is that part of it which stands under the separating line; as in  $\frac{2}{3}$ , 3 is the Denominator.

— of a Reason, is when the Antecedent of a Geometrical Reason, is divided by its Consequent, then the Quotient is called the Denominator of the Reason. Thus the Denominator of the Reason of 2 to 3, is 2 thirds.

*Depression of the Pole*. So many Degrees as you Sail or Travel from the Pole, you

are said to depress the Pole, because it becomes ( respectively ) lower or nearer to the Horizon.

*Descent*, Right of a Sign, is an Arch of the Equator, which descends with the Sign below the Horizon of a Right Sphere, or it is the time the Sign is setting in a Right Sphere.

— *Oblique* of a Sign is an Arch of the Equator, which descends with the Sign below the Horizon of an Oblique Sphere.

*Diagonal*, a line that passes through the Middle of a ny Figure from one Corner to another.

*Diameter*, a line that passes through the Middle of any Figure from one Side to the other.

*Diagram*, a Scheme for the Designation or the Demonstration of any Figure.

*Diapason*, ( a Term in Musick ) an Octave, the Terms whereof are as 2 to 1.

*Diapente*, ( likewise a term in Musick ) its terms are as 3 to 2.

*Diateffaron*, ( likewise in Musick ) its terms are as 4 to 3.

*Difference of Numbers*, is the Remainder when one Number is subtracted from another.

— of Ascension: See *Ascensional Difference*.

— of

— of Longitudes of two places on the Earth, is an Arch of the *Aequator* comprehended between the Meridians of those 2 places.

*Digit*, a twelfth part of the Diameter of the Sun or Moon. Astronomers make use of this Measure in Eclipses.

*Dimension* in Geometry, is length, breadth, or thickness; thus a line has one Dimension, *viz.* length, a Surface 2 *viz.* length and breadth; and a Body or Solid hath all 3 Dimensions.

*Dioptricks*, is a part of Opticks, which treats of the different Refractions of the light passing through Diaphanous Mediums, as the Air, Water, Glasses, &c.

*Dire<sup>ctrix</sup>* of the Conchoid : See *Conchoid* at the End of this Letter. Plat. II. Num. 6.

*Discus*, Disc of the Sun or Moon, is their round Phases (or Faces) which at their great Distances appear plain or like Dishes.

*Distance*, [in Navigation] is the Number of Degrees or Leagues, &c. that a Ship has sailed from any given Point.

*Division*, [in Arithmetick] is the Rule to divide a greater Number by a less.

— In Geometry changes the Species of Quantity, *viz.* a Surface divided by a

line, gives a line; a Solid by a line gives a Surface, &c. just in the Retrograde way to Geometrical Multiplication, which makes the Species higher, as a line by a line gives a Surface, &c.

*Diurnal*, of or belonging to the Day, the Diurnal Motion of a Planet is so many Degrees and Minutes, &c. any Planet moves in 24 hours.

— Moreover the Motion of the Earth about its own Axis, (in the Copernican System) is called its Diurnal Motion, which causes the Vicissitudes of Day and Night.

*Dodecagon*, a Regular Polygon consisting of 12 equal Sides and Angles.

*Dodecaedrum* : See *Bodies Regular*.

*Dodecatomy*, the twelve Signs, *Aries*, *Taurus*, &c. so called, because each of them is the twelfth part of the Zodiac.

*Dominical Letter*, one of the first seven Letters of the Alphabet wherewith the Sundays are marked throughout the Year in the Almanack.

*Dorick Order*, one of the five Orders in Architecture, wherein the Simple Columns without Pilasters are seven, or according to *Pallad.* 8 Modules in length.

*Dra-*

**D**ragon, a Constellation. **Dragon's Head and Tail**, two Points of Intersection, where the Orbit of the Moon cuts the Orbit of the Sun, and the Ecliptick. These two Intersections are called also Nodes, whereof that which is at the Passage from the South to the North, is called the ascending Node, and Head of the Dragon, and is denoted by this Character (88); the other which is at the passage from the North to the South, is called the southern or descen-

ding Node, or Dragon's Tail, and is thus characterized (88).

A Drift at Sea, is any thing floating that is of Wood.

Duplicate Reason, or Proportion: See Reason.

Duplication of the Cube, is to find the side of a Cube which shall be double of a given Cube.

Duration of an Eclipse, is the time the Sun or Moon remain eclipsed, or in any part obscured.

**E**ccentric, not having the same Center with any other Circle assigned. A Term used in the Ptolemaick System of the World.

**E**clipse of the Sun, is the privation of its light in respect to us, by the Interposition of the Moon's Body between it, and our sight; so that it is rather indeed an Eclipse of the Earth.

**E**clipse of the Moon is the privation of the Sun's light to the Moon by the Interposition of the Body of the

Earth between the Sun and it.

— Partial when they are only eclipsed in part.

— Total when they are wholly eclipsed.

**E**ccliptick, [ so called, because the Sun and Moon are always eclipsed in it ] is an imaginary Circle in the Heaven, moreover called *Via Solis*, the Sun's way, because the Sun never goes out of it: It is in the Middle of the Zodiack.

**E**lements, ( in Mathematics ) are the first Principles

bles and Rudiments of those Sciences. Thus Euclid's Elements contain the first Principles and fundamental Propositions of Geometry. Moreover, a Point, Line, and Surface are termed the first Elements of Magnitude, *viz.* a Point in respect of a Line, a Line in respect of a Surface, and a Surface in respect of a Solid.

*Elevation of the Pole*, is the Arch of the Meridian comprehended between the Pole and the Horizon: This Arch is always equal to the Latitude of the Place which is nothing but the Arch of the Meridian comprehended between the Equator and the Zenith of the Place.

*Ellipsis*, or *Ellipse*, commonly called an Oval, is a Curve-line comprehending or including a Space longer one ways than the other, and having drawn a line long ways from one end to the other, there are two Points in that line equally distant from each End, from which Points drawing two right lines to any Point in the Periphery, their Sum is always equal to that right line (which is called the Transverse Axis) which goes from the one end to the other.

*Emersion*, when a Star approaches so nigh the Sun,

that it cannot be seen for the Sun's light, it is called its immersion, *q. u.* and when it begins to appear again as coming out, it is called its Emersion. The word is sometimes also used for the Sun or Moons coming out of an Eclipse.

*Eminence*, is a Rising or Elevation of any Hill or Place.

*Engine* : See *Machine*.

*Engineer*, a Person employed in building or attacking a Fort, or fortifying or besieging a Place or Town.

*Enneadecaterides* : See *Cycle* lunary.

*Enneagon*, a Polygon of 9 sides.

*Epact*, is the Difference between the common solar and lunar Year: Thus, as the common solar Year consists of 365 Days, and the common lunar one of 354, it follows that the Epact is 11 Days, which added to the common lunar Year gives the common solar one.

— of the Year is the Age of the Moon at the beginning of each Year, that is the time the between first Minute of the first Day of January, and the last new Moon of the precedent Year. The Epact of a common Year is 10 Days 15 Hours, 11 Minutes, 22 Seconds, and the Epact of a Bissextile Year is 11 days,

11 days, 15 hours, 11 minutes, 22 seconds.

*Ephemeris*, (a Diary or Day-book:) Amongst Astronomers Ephemerides are those Books which contain the daily Motions of the Planets and other Stars with their Aspects, and places throughout the Year.

*Epicycle*, a small Orb on the Circumference of which the Planets were imagined to be fastned; and moved round its Center, which was also carried round another Circle called the *Deferent* of that Epicycle. These were part of the *Farrago* of the Ptolemaick Hypothesis which is now quite out of doors.

*Epistyle*: See *Architrave*.

*Epocha*: See *Aera*.

*Equation*, [in *Algebra*] is a Comparison between two Quantities (or Members of the Equation,) to make them equal. They are commonly joined by one of these Characters = or  $\approx$  as  $aax = bba$ , which denotes  $aax$  to be equal to  $baa$ .

*Equator*: See *Equinoctial*.

*Equilibrium*, is Equality of Weight; as, e.g. Two weights in a balance being equal are said to be in *Equilibrio*.

*Equimultiples*, are Numbers that contain their Submultiples an equal Number of times; as 12 and 6 are Equimultiples of their respe-

tive Submultiples 4 and 2, because each contains its Submultiple thrice.

*Equinoctial*, or *Equator*, which Sea-men by way of Prerogative call the *Line*, is a great Circle dividing the Sphere into two equal parts. It is called by that Name, because twice in a Year, when the Sun enters into *Aries* and *Libra* in this line we have equal Day and Night, or the Vernal and Autumnal Equinox.

*Equinox*, Equal Day and Night as above.

*Equicrural*, a Triangle (or anything else) that has two equal Legs or Sides.

*Even Number*, is a Number that may be divided into two equal parts without any Fraction, as 4 and 6 into 2 and 3.

*Evenly even*, is a Number, which an even Number may measure by an even Number, as 64 is evenly even, because 16 which is an even Number, measures it by 4 which is an even Number also.

*Evenly odd*, is that which an even Number may measure by an odd one, as 30 which 2 or 6 even Numbers do measure by 15 or 5 odd ones.

*Extraction of Roots*, is the finding a Number which being multiplied by it self once

## EX

once or twice or thrice, &c. gives the respective Power out of which the Root proposed was to be extracted; as if 16 be proposed to extract the Square-root of it, ( the Square being only a Number once multiplied by it self ) you'll find it to

## EX

be 4, for 4 times 4 makes 16. See also Root.

*Extream Reason*: See Reason.

*Extuberances*, swellings, standings out, or Convexities, whether regular or irregular.

## FA

**F**ace of a Bastion, the two foremost Planes of the Bastion as FK and GL. *Fascines*, are Fagots made of small Wood, bigger or less according as occasion requires. Sometimes they are dipped in Pitch and made use of to burn some Work of the Enemies. Sometimes they are made use of to fill up Ditches of Water for passage over, and for several other Uses in Sieges, &c.

*Fasti*, were Days among the Romans that the Lawyers were permitted to plead in like our Term-time; and they called their Vacations, *Dies Nefasti*, according to that of Ovid.

*Ille Nefastus erat per quem  
tria verba silentur,  
Fastus erit per quem iure  
licebit agi.*

## FL

*Feria*, Holy-days.

*Figure*, is a Space terminated by one or more Extremities or Bounds.

*Figurate Numbers*: See Numbers.

*Finitor*, the Horizon or great Circle that divides the upper Hemisphere from the lower, is so called; as terminating our sight.

*Firmament*, the eighth Heaven among the Ptolemaists, or the Heaven of the fixed Stars, called also the *Primum Mobile*, q. v.

*Fixed Signs*: See Signs.

*Flank* ( in Fortification ) is a part of the Bastion, which beginning from one End of the Cortin, reaches to one End of the Face; as IL or HK.

*Flux and Reflux*, is the Tide and Ebb, or High and Low

Low Water of the Sea, or any River.

*Fluxions*, in *Geometry* is a new Improvement of it upon the Doctrine of *Indivisibles* and *Arithmetick of Infinites*; invented by the celebrated Mr. *Newton* of *Cambridge*; though at the same time or thereabouts, also found out under other Terms and a different way of Notation by the *Heer Leibnitz* of *Germany*, and passes there and in *France*, under the Name of *Leibnitz's Differential Calculus*, or *Calculus of Differences*, which *Differences* or *Fluxions* are supposed to be Quantities infinitely small, whereby finite ones considered as indeterminate are perpetually augmented or diminished, which upon that Account are called by Mr. *Newton* *Flowing* ones. Hence Geometricians contemplate the Generation and Nature of Curvatures of infinite kinds, whereby they come to compendious Methods of, 1. Finding Tangents to all sorts of Curves; 2. Rectifying the Curve-lines, 3. Finding their Areas, Solidities, &c. 4. Finding the *Maxima* and *Minima*, and almost whatever besides the most intricate and reclusive Parts of *Geometry* require. Mr. *Newton's* way of Notation herein will be found

the most easie and natural, a Specimen whereof may be seen in the 2d. Vol. of Dr. *Wallis's* Works, the last Edition, Printed in Latin, &c.

*Focus of a Parabola*, is a Point in the Ax. of a *Parabola*, within the *Parabola* distant from the Vertex or Top one fourth part of the *Parameter* or *Latus Rectum*.

— of an *Ellipsis* which has two *Foci* or *Focus's*, are two Points in the Transverse Axis of the *Ellipse*, from whence if you draw two lines to any Point of the Circumference, the Sum of them is Equal to the Transverse Axe.

— of an *Hyperbola*, is a Point in the indeterminate Ax, the Distance whereof from the Center of the *Hyperbola*, is equal to a part of one of its *Asymptotes* comprehended between the Center and the Tangent to the Vertex of the indeterminate Ax, which is perpendicular to that Ax.

— of a *Glass* or *Speculum*, is the Point where the Rays of the Sun are united, whether by Refraction or Reflection.

*Force* ( in *Mechanicks* ) which is also called *Power*, is whatever is, or may be made the Primary (terrestrial) Cause of any Motion of Bodies; as Weight, Water, Men, Hor-

ses, &c. in Relation to the Body or Weight to be moved: See further our short Appendix of it at the End of this Dictionary.

*Forestaff* or *Crossstaff*, an Instrument made use of at Sea for observing the Sun or Stars, &c. with ones Face towards the Object, in Contradistinction to *Backstaff*, &c.

*Fort*, is in general any little Place fortified. And

*Fortress*, any fortified Place where there are also a considerable Number of Houses.

*Fortification*, which is also called *Military Architecture*, is the Art of fortifying any Place, so that it may be easily defended when attacked, and kept from the Enemies making himself Master of it.

*Fraction*, or a broken Number, is that which represents any part of an Unit. It is composed of two parts separated by a line thus,  $\frac{2}{3}$ , and the Number above the line is called the *Numerator*, and that under the line the *Denominator*.

— *Improper*, is a Fraction that is greater than an Unit, or whose *Numerator* is greater than the *Denominator*, as  $\frac{5}{3}$ .

*Fractions* of the same Denomination are those, whose Denominators are equal, as  $\frac{1}{5}, \frac{2}{5}, \text{ &c.}$

*Fraction of a Fraction*, is a part of a Fraction: Thus  $\frac{2}{3}$  is a Fraction of a Fraction in respect of  $\frac{1}{3}$ , because it is  $\frac{2}{3}$  of it, for multiplying,  $\frac{2}{3}$  by  $\frac{1}{3}$  you have  $\frac{2}{9}$  or  $\frac{1}{2}$ : Thus also Farthings are Fractions in respect of Pennies, and so may be reckoned Fractions of Fractions in respect of Pounds.

— *Decimal*: See *Decimals*.

*Frigid Zone*: See *Zones*.

*Frustum*, a Piece of any thing cut off as a *Frustum* of a Cone, is a Piece of a Cone, so there often occur in *Gauging* Frustums of Conoids, Spheroids, &c.

*Furlong*, the eighth Part of a Mile.

*Furniture of a Dial*, are Parallels of Declination, Azimuths, &c.

to Abions ( in Fortification ) are great Baskets of five or six Foot high, and four Foot diameter, which they fill full of Earth, and serve for Defences from Bullets in Sieges, &c.

*Galaxie*, in the Heavens, is that parcel of Stars called the milky way. It only casts a whiteness in the Sky to the naked Eye, but by help of the Telescope an innumerable Number of small Stars are discovered, which appearing close together cause that whiteness which we see, which thence is called the milky way.

*Galiot*, a small Galley.

*Gauging*, is the Art of measuring solid Bodies, but in particular those Concave Solids which are in use among Brewers, as Vessels, Tuns, Backs, &c.

*Gemini*, the third Sign in order of the Zodiac thus characterized.

*Genesis or Geniture*, the Formation of Figures by motion, is sometimes called so; Thus a Parallelogram turned about one of its sides as an Ax generates a Cylinder, &c.

*Geocentric* any Motion of

the Planets that has or is supposed to have the Earth for its Center.

*Geodesia*, the Art of Surveying or Measuring Land.

*Geography*, is a Description of the Earth considered as a Spherical Body.

*Geometry Speculative*, or considered as a part of the pure Mathematicks, is the Knowledge of Quantity or the Science of Magnitudes considered abstractedly as such, without any Relation to particular Bodies or Material Beings.

— *Practical*, is the Application of the Theories of Speculative Geometry to humane Uses, as measuring of Land, Solids, Sailing at Sea, &c.

*Globe*, a round Solid which may be conceived to be made by the Circumvolution of a Semi-circle about its Diameter. But the word is now usually attributed to two Artificial Representations of Heaven and Earth; of which one called the Celestial Globe, shews the several Constellations or Stars, the Circles, Longitudes and Latitudes of each part of Heaven, fitted with their

Horizon and Meridian to every Elevation of the Pole, &c. The other named the Terrestrial Globe exhibits on its Surface the Description of the whole Earth and Sea, with its Meridians and Parallel Circles, &c. whereby the Longitude and Latitude and Distances of Places from one another may be presently seen and understood.

*Gnomon* ( in Geometry ) is that part of a Parallelogram, ( after two lines are drawn Parallel to the sides which intersect the Diagonal being also drawn, in the same Point, and so divide the whole Parallelogram into four less ones ) I say, the Gnomon is, that Figure thro' which the Diagonal line does not pass, together with one of those through which it does pass, as ABC exclusive of D4. The Pin or Stile of a Dial, that casts the Shadow on the Hour, is also so called.

*Gnomonice*, the Art of Dialling.

*Golden Number*: See Lunary Cycle.

*Golden Rule*, otherwise called the Rule of Three, teaches to find a fourth Proportional to three Numbers given; it may be either *Direct* or *Inverse*.

— *Direct*, is when the first Term hath the same

Proportion to one of the other two, as the third has to the fourth sought: As for example, if 24 Yards of Cloath cost 52 Shillings, how much will 56 cost.

— *Inverse*, or *Indirect*, is when the third Term bears the same Proportion to one of the other two, as the last to the fourth sought: as if there are required 1728 Bricks four Inches square to pave a Room, how many of six Inches square will serve to pave the same.

*Gorge* ( in Fortification ) is in general any Entrance into the Body of a Work, but in particular the Gorge of a Bastion is that opening which lets into the Bastion, as IM.

*Gravity*, Weight.

— *Specifick*, is that which commonly proceeds from the Densities of Bodies, by which one Body weighs more than another of the same Bulk.

*Great Circles* on the Sphere, are those that divide the Sphere into 2 Hemispheres, or into two equal Parts; such are e. g. the Horizon, Meridians, Ecliptick, &c. on the Globe.

*Great Circle-sailing*, is sailing in a great Circle of the Sphere.

*Gregorian Year*, is the Reformation of the Calendar made

## G U

made by Pope *Gregory the 13th.* which we call the New Style.

*Gulf*, is a Place in the Sea, or in a River, in which the Water turning continually round swallows things that come into it.

*Gun-Chain*, *Quadrant*, *Gunter's Rule*, *Scale & Sector*, are all useful Mathematical

## G Y

Instruments, invented, or much improved by that ingenious Mathematician Mr. *Edmund Gunter*, sometime Professor of Astronomy in *Gresham College* in *London*, and from him taking their Names.

*Gyration*, a Whirling-round.

## H E

**H**alo, a Circle about the Sun or Moon : See *Parhelion*.

*Harmony*, is an Agreement of two or more Sounds at the same time.

*Harmonick Proportion*: See *Proportion*.

*Height* : See *Altitude*.

*Helena*, a sort of Light or Fire that sometimes appears about the Masts and Yards of Ships; when it is double they call it *Castor* and *Pollux*, q.v.

*Heliacal* [Rising of a Star] is when a Star gets from under the Sun's Beams.

— [Setting of a Star] is when it becomes inconspicuous by the near Approach of the Sun.

*Heliocentric*, respecting the Sun as the Centre of the Universe.

## H E

*Helicometry*, the Art of measuring Spiral-lines; from *Helix*, a Spiral-line.

*Hemisphere*, is the half of a Sphere cut by a Plane thro' the Centre.

— The Equator also divides the World into two *Hemispheres*, the one Northern, the other Southern; from the Equator to the North-Pole, is the Northern-Hemisphere or part of the World, and from the same to the Southern or Antartick-Pole, is the Southern-Hemisphere or part of the World.

The same Division may be also made on the Globe by a Meridian, and it is sometimes reckoned to be so divided into an Eastern and

We-

Western-Hemisphere, and according to that Division *England* will be in the Western, as by the former it is in the Northern-Hemisphere.

*Heptagon*, a Figure that has seven Sides and as many Angles.

*Hesperus*, the Name of the Evening-star.

*Heteroscti*, People that have their shadows cast but one way at Noon. Such are all the Inhabitants of the Temperate Zone, as the *English*, &c.

*Heterogeneous*, things of a different kind.

*Hexagon*, a Figure consisting of six Sides and Angles.

*Holometrum*, the Name of a Mathematical Instrument for measuring of several things invented by one *Abel Tull*, who published a Book of its Use.

*Homocentric*, having the same Center.

*Homogenal*, of the same kind or sort.

*Homogenum Comparationis*, the absolute given Quantity of an Equation, as suppose  $x^3 - axx = bcc$ , the *Homogenum Comparationis* there is  $bcc$ .

*Homologous*, Magnitudes, in Proportionals, are Antecedents to Antecedents, and Consequents to Consequents, as if there be the same Pro-

portion of A to B, as of C to D; then A and C, B and D, are Homologous.

*Horizon*, is a great Circle of the Sphere, which separates or divides the upper Hemisphere from the lower; that is, that half of the World which we see from that half which we cannot see. There are two sorts of Horizon's made mention of amongst Astronomers, viz. the

— *Visible or Sensible*, which is that part of the World, or of the Hemisphere that we can discover with the Eye, and is terminated with the sight.

— *Rational or Astronomical*, is that Plane which passes through the Center of the Earth, the two Poles whereof are the Zenith and the Nadir.

That the Reader may the better comprehend these two Circles, which are of great Use, we thought fit to add the following Scheme, wherein the Interior Circle represents the Earth, and the Exterior one the Heaven, the line AB, which passes through C, the Center of the Earth, and Heaven represents the Rational Horizon, and the line DE, which touches the Surface of the Earth in F, represents the Sensible Horizon, which

which always in respect of the same Place of the Earth is parallel to the Rational one.

*Horizontal Line*, any Line drawn parallel to the Horizon upon a Plain or Dial.

*Horizontal Projection*: See *Projection*.

*Horologiography*, the Art of making Clocks, Dials, &c.

*Horometry*, the Art of measuring Time by Hours, &c.

*Hour Circle*, is part of the Furniture of a Globe, being a small Brazen Circle fitted on the Meridian, whose Centre is the Pole of the World, divided into 24 Hours, which in one Revolution of the Globe are all pointed at with an Index for that purpose fitted on the Axis of the Globe.

*Hydrostatics*, is an Art which teaches and compares the Weights of Bodies in Water. It was by this Art *Archimedes* found out the Cheat of King *Hieron's* Crown, which, instead of Gold, was made of mixed Metal: See *Vitruv.* at beginning of his 9th. Book, *Chap. 3.*

*Hydraulic Engines*, are Engines for raising of Water; either by Water, Horses or any other Force.

*Hydrography*, a Description of the Water, as of the Sea, or Rivers, Lakes, &c.

*Hydromancy*, Divination by Water.

*Hygrometer*, an Instrument to measure the Moisture of the Air, it is also called by the Name of *Hygroscope*.

*Hyperbola*: See our Appendix of Conick Sections.

*Hypobasim*, is an equal Depression of all the Terms of an Equation when the unknown Quantity is multiplied into them all, *viz.* by dividing them all by that unknown Quantity, or any of its Powers that are so involved, as *e. g.* the following Equation  $x^4 + 2ax^3 = bbxx$ , by dividing it by  $xx$ , which is multiplied into all its Terms becomes  $xx + 2ax = bb$ .

*Hypomoclion*, otherwise called the *Fulcrum* or *Prop*, is ( in Mechanicks ) the fixed Point, or the Center of Motion of a Body, or Engine by which it is suspended, or on which it any way rests in its Motion. Thus in a Balance the Point on which the Beam moves is its Hypomoclion, in one sort of a Lever that Point or End which rests on the Ground or on any Plane, or in the other that Point where-ever it be that rests on any sort of Prop between the Weight and the Power.

## H Y

*Hypothenuse*, in a Right-angled Triangle, is that side which is opposite to the Right-angle.

*Hypothesis*, is a Supposition; among Mathematical Principles Postulates are sometimes so called. The different Systems of the

## H Y

World are also called by that Name.

*Hypotrachelium* ( in Architecture ) is a narrow part near the Capital.

*Hydrodromy*, the Method or Art of carrying a Ship on the Sea.

## I M

*Jacob's Staff*, a Mathematical Instrument for taking Heights and Distances.

*Iconography*, is the Orthographic Projection of any Object; the Art of making Models, Patterns, &c.

*Icosaedrum*, is ( one of the Regular Bodies ) a Solid comprehended under 20 equal and equilateral Triangles.

*Ides*, were eight Days after the *Nones*, ( viz. ) on the 15 Day of *March, May, July, and October*, and the 13 Day of the other Months: See *Calends*.

*Ignis fatuus*, is that Fire or Light called commonly *Will in a Wisp*.

*Immission*, of a Star when it approaches so near the Sun as to be hidden in its

## I N

Beams. The beginning of an Eclipse of the Moon is also so called when it begins to be obscured, or enter into the Shadow of the Earth.

*Impure Logarithm*, or *Defective*, is the Logarithm of a Fraction.

*Incidence*: See *Angle*.

*Inclination*, of a Right-line to a Plane, is an acute Angle which that line makes with any line of the Plane, towards which it inclines or leans.

— of two lines, is the meeting of two lines which intersect one another.

— of a Plane is the small Arch of a Vertical line perpendicular to the Plane comprehended between the Plane and the Horizon.

— of

— of a Ray, is the Angle which that Ray makes with the Ax of Incidence, in the first Medium at the Point where it meets or enters the Second, that is at the Point of Incidence: As if EF be a Ray of light, The Inclination of that Ray will be the Angle EFI.

*Incommensurable Quantities*, are Quantities between which there is no common Measure of the kind can be found. Thus the Diagonal and Side of a Square are incommensurable lines.

— in *Power*, when between their Squares also there can be found no Area, that can be a common Measure, or exactly measure both, &c. *Ad Infinitum*.

*India*, the farthest Parts of the World Eastward, go by the Name of the East-*India*, or *Indies*; and *America*, by the Name of the West-*Indies*.

*Indices* ( *Index* in the singular Number ) the hand of a Clock, &c. and the Pins that direct to Figures on several Instruments are called by this Name.

— in *Algebra*, the Exponents of Powers are also called by this Name, as two is the Index or Exponent of the second Power or Square, three of the third Power or Cube, four of the fourth or

*Biquadrate, &c. ad Infinitum.*

*Indiction*: See *Cycle*.

*Indivisibles*, a Method in Geometry, supposed to be invented by *Archimedes*, and known to the Ancients by the Name of the *Method of Exhaustions*, and revived again by *Cavallerius*. It supposes plane Figures to be composed of an infinite Number of indivisible Lines, and Solids of an infinite Number of Planes or Surfaces, which are also called the Elements of those Planes and Solids; by this Method several Theorems of Geometry are easily demonstrated, which otherwise are very difficult, as the finding the Area's of plain curvilinear Figures, and the Solidity of curve Solids, &c.

*Ingress* ( Entrance ) the Sun's Entrance into any of the Cardinal Signs is called by this Name.

*Inscribed*, Figures are those which are drawn within others; as a Circle drawn within a Square is said to be inscribed in that Square.

*Integer*, whole Numbers are called by this Name in Contra-distinction to Fractions.

*Intercalary day*, the odd day intercalated or put in the Leap-year, whereby the 6th Calends of March ( that

is with us the 24th of February,) was reckoned twice.

*Intersection*, a Cutting off or through.

*Interlunium*, when the Moon has no Phasis or Appearance, as being in Conjunction with the Sun, i. e. New Moon, the time wherein she then disappears is called by this Name.

*Interval*, Distance.

*Invest* to besiege a Place closely, so as to stop all its Avenues, and cut off all Communication with any other Place.

*Inverse Reason*: See Reason.

*Ionick*, one of the five Orders of Architecture: See Order.

*Journal* (a Day-book) in Navigation for keeping an Account of the Ships way at Sea; the Changes of the Wind, and several other remarkable Occurrences.

*Iris*, the Rain-bow.

*Irrational lines*: See Incommensurable Quantities.

*Izagon*, a Figure consisting of equal Angles.

*Isochrone*, is a Term used in the Vibrations of Weights or Pendulum's, and signifies Equality of time; as the

Vibrations of Weights which hang on equal Cords or Strings are Isochronous.

*Isomeria*, is a Method of freeing an Equation from Fractions; which is done by reducing all the Fractions to one common Denominator, and then multiplying each Member of the Equation by that common Denominator; thus e. g.  $\frac{1}{2}x^3 + axx - bcc\bar{x}$

— — —  $abb$  becomes  
a  
this, viz,  $ax^3 + 4aaxx - 4bcx = 4aabb$ .

*Isoperimetral Figures*, are such as have equal Circumferences.

*Isoceles Triangle*, is a Triangle that has two equal Legs.

*Isthmus*, is a Neck of Land which lies between 2 Seas, and joins one Land to another.

*Julian Year*, the old Stile or Account of Time; so named from Julius Cesar, and called old in Contradistinction to the Gregorian or New Stile.

*Jupiter*, one of the Planets, the highest except Saturn.

# K A

**K Alends** } See  
**K Kalendar**, } *Calends.*

# L A

**L Area Via:** See *Galerie*.  
**Latitude** (in Geography of any place on the Earth,) is an Arch of the Meridian intercepted between the Equator and Zenith of that Place, numbered on the Meridian from the Equator 90 Degrees both ways, *viz.* North and South.

— in Astronomy, is the Space that any Planet or Star does at any time deviate from the Ecliptick towards either of its Poles; and as this Deviation is either North or South, it takes the Denomination of either North or South Latitude.

— *Southern* of any Star, is the Distance of that Star from the Ecliptick towards the South or Antartick Pole.

# K N

**Knot**, the line the Seamen call a Log-line, is divided into Knots: See *Log-line*.

# L E

— *Northern* of any Star, is its Distance from the Ecliptick towards the North Pole.

— *True*, is the distance of the true place of a Planet from the Ecliptick.

— *Apparent*, is the distance of the apparent Place of any Planet from the Ecliptick.

**League**, is commonly reckoned to be three Miles in length.

**Legs**, the Sides of Triangles are sometimes so called; particularly the two sides of a Right-angled Triangle that comprehend the Right-angle.

**Lemma** (in the Mathematicks) is a sort of a preparatory Proposition which is brought in on purpose to de-

demonstrate ( or facilitate the Demonstration of ) some ensuing Theorem, or to construct some Problem.

*Leo*, ( the Lion ) the fifth Sign in the Zodiack, characterized thus (  ).

*Letters Dominical*, are the first seven Letters of the Alphabet which serve each in their Turn, to mark out the seven Days of the Week ; and one of the seven consequently to stand always for Sunday ( or Lord's Day ) whence they are so denominated.

*Levant*, the Eastern parts of the Continent, are so called, as *Asia*, &c.

*Level*, an Instrument used by Carpenters, and other Artificers for trying whether Plains, as Boards, &c. lie Horizontal.

*Lever or leaver* ( in Mechanicks ) is one of the Principles of Mechanicks, and is nothing but a Balance resting, instead of hanging, on a certain determinate Point called its *Fulcrum* or *Hypomotion*, and so lifting up any given Weight ; another Difference is this, that in the common Balances, the Center of Motion is in the Middle, but may be in any Point in the Leaver. Of Leavers there are several kinds.

— of the first kind, is that which has its fixed Point ( or *Fulcrum* ) C between the Weight D, and the Power B. To this sort of Lever may be referred Scissars, Pincers, Tongs, Snuffers, &c.

— of the second kind has its *Fulcrum* C, at one of its Ends, and the Weight D between the Center of Motion C, and the Power which is at the other End B. Lastly the

— of the third kind, is that which has its Center of Motion C at one End, the Weight D at the other End A, and the Power between both as in B.

*Libra*, ( the Balance ) one of the Signs of the Zodiack exactly opposite to Aries, characterized thus .

*Libration*, the Motion of swinging in a *Pendulum*.

— of the Moon ; it has been observed by help of Telescopes, that the Moon sometimes turns certain Spots on one side towards the Earth, and that then they are hid, and others invisible before appear on the contrary side, and so by turns she shews first the one, and then the other ; which has given occasion to our Astronomers thence to suppose that she has such a Motion continually,

ally; which they thence call *Motus Libratorius*, the Libratory Motion of the Moon.

*Limbus*, the outermost Limb, or Border, or Edge of any thing, as of an Astrolabe, &c.

*Line* ( in Geometry ) it is defined length without breadth. It may be either

— Right, whose Points are equally placed between the two Extremes, which are always Points, or

— Curve, whose Points are not equally placed between its two Extremes: These are either Regular or Irregular.

— Regular ones are those which have every where the same sort of Curvature as the Conick Sections, &c.

— Irregular ones are those which have a certain Point of Inflection; i. e. which being continued bends a quite contrary way as the Conchoid, Cubick Paraboloid, &c. Both Regular and Irregular Lines may be either *Mechanical* or *Geometrical*.

— *Mechanick*, is a curve Line, the Relation of whose Points to a right Line cannot be expressed by any Equation. Such is the *Quadratrix* of *Dinostratus*, and several others. See the End of this Letter.

— Geometrical, is a Curve, the Relation of whose points to a right Line may be expressed by an Equation. And it's call'd a

— of the *first Gender*, if the Equation consists but of two Dimensions; such are the Conick Sections, but

— of the *second Gender*, when the Equation consists of three or four Dimensions, such are the Cubick Paraboloid, *Cissoid*, *Conchoid*, &c. And,

— of the *third Gender*, when the Equation consists of five or six Dimensions, &c.

*Line of Defence* ( in Fortification ) is in general the right Line, along which the Musket-shot is made to defend the Face of a Bastion.

— of *Approach*, and of Attack, are Ways or Trenches dug along in the Earth in shape of a Ditch; the Earth is cast up to make Parapets, q. v. on the side of the place besieged, especially when the Earth is easie to be dug up; but if it be rocky, they are made of Fascines, Gabions, Packs of Wool, &c. which make no noise in Carriage and Laying, &c.

— of *Circumvallation*, is a Line made round a Camp, And

— of *Contravallation*, is a Line made between the Camp and the Place besieged for the safety of the Besiegers.

— of *Communication*, are those which go from one Part of the Works to another.

— of Numbers, Lines, Chords, Tangents, Secants, Sines, &c. See *Scale*.

— *Conick*, is a Curve-line which terminates a Conick Section; thus a

— *Parabolick*, which represents the Circumference of a *Parabola*; and

— *Hyperbolick*, which represents that of an *Hyperbola*; and

— *Elliptick*, which represents the Circumference of an *Ellipsis*.

— *Meridian*, the 12 a Clock-line on Dials is so called.

— *Loxodromick*, is the Line of a Ship's way, or which a Ship describes ( when she does not go in a right Line, which always happens ) in long Navigations.

*Log*, — a Line to find the way or distance a Ship runs at Sea, by help of a Minute-glass.

*Logarithms*, are Numbers in Arithmetical Progression, answering to so many Numbers ( set over-against them ) in Geometrical Progression,

of which they are called the Logarithms. Thus the Numbers of this Arithmetical Progression 0, 1, 2, 3, 4, 5, &c. are the Logarithms of the Numbers of this Geometrical Progression 1, 10, 100, 1000, 10000, &c. They perform Multiplication by only Addition, and Division by Subtraction.

*Logistica*, is Specious, or Numeral: See *Algebra*.

*Longimetry*, is the Measure of Lengths.

*Longitude* ( in Geography ) is an Arch of the Equator comprehended between the first Meridian, and the Meridian of the Place you enquire after; and shews how much one Place is more Eastern or Western than the other.

— ( in Astronomy ) of the Stars, is reckoned in the Ecliptick from the first Degree of *Aries* to the last of *Pisces*; and this by Circles passing through the Poles of the Zodiack, and each of its Degrees at opposite Places. So that the Arch of the Ecliptick intercepted between the first Degree of *Aries*, and that Circle which passes through the Center of any Star, is the Longitude of that Star.

*Lucifer*, the Morning Star, *Venus* is so called when she rises before the Sun; as also *Pho-*

## L U

*Phosphorus*: So when she sets after the Sun, she is called *Hesperus*, or the Evening-star.

*Luminaries*, the Sun and Moon are so called by way of Emphasis; for the extra-

## L U

ordinary Light we receive from them.

*Lunation*, the *Synodical Month* is reckoned from one Conjunction of the Moon with the Sun to another; and called by this Name.

## M A

**M**achine, is any Engine or Contrivance made of several Parts, as Wheels, Springs, &c. for the augmenting or diminishing the Force, or Motion, or Weight, &c. of Bodies for several Uses; in War, Architecture, and other Arts.

*Magazine*, a Store-house for Arms or Provision, &c.

*Magnitude*, is continuous Quantity, or Extension.

*Mapp*, a Geographical (either general or particular) Chart, or Description of the World, or any Part thereof in *Plano*.

*Marine*, of or belonging to the Sea, from *Mare* the Sea.

*Mariner*, a Sea-man.

*Mars*, one of the Planets.

*Mast*, is a part of a Ship whereon the Yards are fastened; and to them the Sails.

*Mathematicks* (from *Mathesis*, which though it signific only *Discipline*, yet) they deserve the Name of Sciences better than any other; for their Principles are self-evident, and their Demonstrations unexceptionably clear, and indisputably true, and as such, may be defined) the Sciences of Magnitude and Numbers, or of quantity continued and discrete, which are the proper Subjects of

*Mathematicks pure*, which treat only of Magnitude and Number considered abstractedly from any Matter, as far as they are subject to, or capable of Mensuration on the one hand, or Arithmetical Calculations on the other; to these also may be referred Motion considered abstractedly, and as capable of different Degrees of Velocity.

losity, &c. of this sort are abstracted Arithmetick and Geometry in their largest significations, on the one hand comprehending Algebra, &c. both Numerical and Specious, on the other the Elements of Geometry, Trigonometry, Conick Sections, Constructions of Equations, &c.

— *Mixt*, are those Arts and Sciences which consider and treat of the Properties of Quantity applied to material Beings, or sensible Objects, as Astronomy, Cosmography, Opticks, Musick, Gauging, Surveying, Navigation, &c.

*Matutine*, of or belonging to the Morning.

*Maxims* : See *Axioms*.

*Mean Diameter* ( in Gauging ) is a Geometrical Mean between the Diameters at Head and Bung, in a close Cask.

*Mean Proportional* in Geometry, is when in 3 Quantities there is the same Proportion of the first to the second, as of that second to a third ; the second is called a mean proportional, as in 2, 4, 8, there is the same Proportion of 2 to 4, as of 4 to 8, where 4 is the mean proportional. In Arithm. or Mus. the 2d of any 3 Proportionals is called the mean.

*Mechanicks* in general, is the Science of Motion ; in

particular the Doctrine of Machines, viz. to move any given Weight by any given Power, & treats chiefly of the

*Mechanick Powers* or Principles are commonly reckoned six, viz. the *Libra* or Balance, 2 *Vestis* or Lever, 3 *Trochlea* or *Pully*, 4 *Cochlea* or *Screw*, 5 *Axis in Peritrochio* or *Windlace*, and 6 *Cuneus* or *Wedge*. See further at the End of this Dictionary.

*Meridian*, is a great Circle which passes through the Poles of the World, and through the Zenith of that place of the Earth, whereof it is the Meridian. Whence it follows that it divides the Equator and Horizon at Right-angles, and the whole World into two Equal parts, whereof the one is called Eastern, the other Western. This Circle is called Meridian, because it is Noon to all those who are situated under it when the Sun comes to it, and likewise at the same time Midnight. We begin our first Meridian at Teneriffe, and count Eastward to 360 gr. round the Globe, but only every tenth is thereon delineated to avoid Confusion, so that there are but 36 marked round the Globe.

*Meridional*, *Southern*, or towards the South.

*Mercator's Chart*, or *Projection*, a Projection of the Earth

Earth in *Plano*, first performed by Mr. *Wright*, but the first Charts so made were published by *Mercator*, and so have ever since been called by his Name.

*Mercury*, one of the Planets which constantly moves about the Sun.

*Mesolabum*, an Instrument Mathematical, invented by the Ancients to find Mechanically two continual mean Proportionals between any two lines given.

*Metonick-year* (from one *Meton* the Inventor of it) is the space of 19 years, in which the Lunations return and begin again as they were before.

*Million*, Ten hundred thousand, are so called.

*Milky-way*: See *Galaxie*.

*Minotaurus*, or *Centaur*, one of the Southern Constellations.

*Minute*, the 60th part of an Hour; also (in Geometry) the 60th part of a Degree.

*Mirrour*, which we also call *Speculum*, is the Surface of any opaque Body, polished and fit to reflect the Rays of Light that fall on it.

*Model*, the Shape or Design of any thing in little.

*Module*, a Measure in Architecture, commonly the Diameter of the Bottom of a Pillar in each Order, by which they measure the

length, &c. And is commonly divided into 60 parts called Minutes, except in the Dorick, q. v.

*Moment*, in common use, is any very small part of time, but among Mathematicians it is an indivisible part of it (if that be possible) and bears the same relation to time, as a point to a line.

*Month*, the space of 30 Days in common Computation.

— *Astronomical*, is precisely the 12th part of a year, or the time the Sun employs in passing through one of the Signs of the Zodiac.

*Monochord*, among the Ancients was an Instrument that had but one Chord.

*Monomial*, is a Magnitude of one Name, or one only Term, as ab, aab, aaab, &c. it may be either

— *Rational*, which is that to which there is no Radical Sign prefixed, as the precedent ones ab, aab, &c. or

— *Irrational*, which has a Radical Sign prefixed, as  $\sqrt{ab}$ , or  $\sqrt{3}$ .

*Monomials*, may be also either

— *Commensurable*, which are those whose Proportion may be expressed by two Rational Numbers, and then they are called commensurable.

ble Roots; as  $\sqrt{2}ab$ ,  $\sqrt{8}ab$ , because their Proportion is equal to that of the two Rational Numbers 1, 2. It is evident that all rational Monomials are commensurable.

— *Incommensurable*, are those whose Proportion cannot be expressed by two rational Numbers; and then they are also called incommensurable Roots; as  $\sqrt{2}ab$ ,  $\sqrt{6}ab$ , because their Proportion is equal to that of these two Numbers 1,  $\sqrt{3}$ , which are not rational to one another.

*Mortar*, a Piece of Artillery of a large Bore, short, to shoot Bombs, Carcasses, &c. with

*Moveable Feasts*, are those Festivals which though they are celebrated on the same Day of the Week, have no fixed Seat in the Calendar, but in several Years happen on several Days of the Month; of which kind besides *Easter* and *Whitsuntide*, are all the Sundays in the Year, &c.

*Mosaick-work*, (*opus Mosaicum*) is Work made of several small Pieces, and Bits of different Colours, whether of Wood or Stone.

*Multangled*, Figures that have many Angles.

*Multilateral*, Figures that have many sides.

*Multinomial*, Quantities composed of several Names, or Monomes joined by the Sign + which signifies *more*, or *addition*, or else by the Sign — which signifies less or subtraction. Thus  $a + b + c - d$  or  $a - b + c - d$ , &c. are Multinomials.

*Multiple*, is a greater Number that contains a less, a certain Number of times without any Remainder; thus 12 is the Multiple of 3, because it contains it exactly 4 times.

*Multiplication*, is the finding a Number equal to the Product of 2 other Numbers of the same, or of a different kind. It may be either Simple or Compound.

— *Simple*, is the Method of multiplying one *Simple* Number by another.

— *Compound*, is the way of multiplying a Sum compounded of several different Species by another also compounded of several different Species, or also by any other simple Number. This Multiplication commonly happens in the Rule of Three, and also in Practical Geometry for measuring Plains and Solids.

— *Geometrical* changes the Species: Thus to multiply a Right-line by a Right-line produces a Rectangle, or

or Plane, and that Rectangle or Plane multiplied again by another line, produces a Solid.

This Multiplication of lines must be conceived to be made by the Motion of a Right-line along another Right-line which is perpendicular to it, will make a Rectangle, and if the lines are equal a Square; and if that Rectangle or Square be again moved along a Right-

line, and at Right-angles, or perpendicular to it, it will produce a Parallelepiped, or a Cube, &c.

*Multiplicand*, is the quantity that is multiplied.

*Multiplier*, is that by which you multiply.

*Musick*, is a Science which explains the Properties of Sounds, as far as they are capable of producing Melody or Harmony.

## N A

**N**adir, is a Point in Heaven directly under us, or opposite to our Vertical Point, or that Point directly over us, which is called our Zenith, q. v.

*Napierbones*, are Instruments invented by the Lord Napier for Multiplication, Division, Extraction of Roots, &c. and are sold at most Instrument-makers Shops.

*Natural Day*, the Space of 24 Hours.

— *Year*, one Revolution of the Sun, or 365 days and almost 6 hours.

## N E

*Navigation*, is the Art of carrying or conducting a Ship at Sea by the help of Charts, Compasses, &c. but particularly by the Assistance of Trigonometry: Taking observations, &c.

*Nautical Chart*,

{ *Compass*, are Instruments for Navigation: See *Chart*.

*Nebulous Stars*, are Stars of a dull, pale and obscure Light.

*Needle*: See *Box* and *Needle*.

*Neomenium*, New-moon.

*Ninth Sphere*; See *Primum Mobile*. G 4 No-

*Nocturnal*, the Name of an Instrument for observing the Stars.

*Nodes*, are Intersections of the Orbits of the Planets, with the Ecliptick; and the Point where a Planet passes over the Ecliptick out of the Southern Latitude into the Northern, is called its North Node, or Ascending Node; and on the contrary, where it passes from the North to the South, is called the Southern and Descending Node; the former also is called the *Dragon's Head*, and this latter the *Dragon's Tail*.

*Nones* : See *Calends*.

*North Pole* : See *Pole*.

*Notes*, (in Musick) are certain Marks which direct the Musician in keeping time, and raising and depressing his Voice; they are commonly represented in a Scale of five Lines.

*Novilunium*, New-moon.

*Number*, is a Collection of Units, and may be either

— *Integer* or Whole

Number, which is so called in distinction to a

— *Fraction*, or broken one, or part of a whole: Numbers are also said to be

— *Square*, when any Number is multiplied by it self, as 16 is the Square of 4.

— *Cube*, when any Number is twice multiplied by it self, as 64 is the Cube of 4; and so onwards *ad Infinitum*; you may make *Biquadrates*, *surfaces*, &c.

*Numerator* of a Fraction, is a Number which expresses the Number of the parts of Unity, or the Whole, you make use of in any Fraction, as in  $\frac{1}{2}$ ,  $\frac{3}{4}$  is the Numerator, as telling you, after you have divided Unity, or the Whole into 4 equal parts, how many of those parts must be taken, viz. 3 of them.

*Numeration*, the Art of reading or expressing any Number set down in Figures, it is commonly taught as the first Rule in Arithmetick.

*Noveminarium*, New-moon.

*Number Spots* : See *Primum*

to stand upright  
or to be upright at once  
and stand upright  
at a standstill.

## OL

*Belisk*, a stone Monu-  
ment in shape of a  
Pyramid.

*Oblique-angle*, is an Angle  
less than a Right one, or  
that consists of less than 90  
Degrees.

*Oblique-ascension*; See *As-  
cension*.

*Oblique-sphere*: See *Sphere*.

*Oblique-signs*: See *Signs*.

*Oblong*, a Parallelogram,  
or Rectangle: Vulgarly, a  
long Square.

*Observatory*, a Place built  
on purpose to make obser-  
vations of the Stars: Such is  
the House in Greenwich-Park.

*Obtuse*, blunt, an Angle  
that is greater than a right  
one, is called obtuse.

*Occident*, the West, or  
Place where the Sun sets.

*Occidental*, Westernly.

*Ocean*, the Seas which en-  
viron Europe, go by that  
Name, and some others: See  
the Maps.

*Otaedrum*, one of the five  
regular Bodies: See *Body*.

*Octagon*, a Polygon of  
eight sides.

*Octave*, or *Diapason*, ( in  
Musick ) its Terms are as  
2 to 1.

*Olympiads*, the Term of  
490 to 360. to 160. to 80.

— *Olympy* about 500. 2000  
years before Christ was living  
among the Greeks.

— *Olympus* is the name  
of a Mountain in Greece.

— *Olympus* is the name  
of a Mountain in Greece.

four Years among the Old  
Grecians, at the End of  
which they used to celebrate  
their Plays, or Games called  
*Olympique*, instituted by *Her-  
cules*, near the City of *O-  
lympus* in *Arcadia*.

*Opposition*, is when two  
Planets are distant from one  
another 180 Degrees, or  
half the Zodiack.

*Opticks*, is a Science which  
considers the sight as direct,  
and any Object as so seen,  
and then explains by the  
Principles of Physick and  
Geometry, the Causes of  
the different Appearances  
that may happen from the  
same Object.

*Orb*, is a spherical hollow  
Body contained under two  
Surfaces, the one Convex,  
the other Concave.

*Orbs Concentrick*, are sev-  
eral Orbs one within another,  
which have the same Cen-  
ter.

— *Eccentricick*, are Orbs  
one within another, or also  
separate, which have dif-  
ferent Centers.

— There may be also  
Orbs partly Concentrick, part-  
ly Eccentricick, viz. such as  
are not of an equal Thick-  
ness,

nes, i. e. such whose External and Internal Surfaces have not the same Center.

*Orbit*, the Path or Way wherein a thing moves round, thus Eclipick is the Sun's Orbit, &c.

*Order*, (in Architecture) is a Rule for the Proportions of the Columns or Pillars, and for the Figures of certain Parts belonging to them, according to their different Proportions. The Ancients had five Orders they made use, viz. The

— *Tuscan*, wherein the Column (or Pillar) with the Base and Chapitel contained in length seven Modules, and the upper part of the Pillar was  $\frac{1}{4}$  less in Diameter than the Bottom.

— *Dorick*, its Pillars, if they are without Pilasters ought to be in length  $7\frac{1}{2}$  Modules, or Eight according to Palladius. Note that in this Order alone a *Module* is only the Semi-diameter of the Column, or 30 parts.

— *Ionick*, its Pillars with the Chapitel and Base, are in length 9 Modules. The Architrave, the Frise and the Cornish are the fifth part of the height of the Column.

— *Corinthian*, the same with the Ionick except in the Chapitel. The flourishing is somewhat different.

— *Composite Italick*, or *Roman*, is composed of the Ionick and Corinthian.

*Ordinate* in a *Parabola*, is a line drawn through the Ax, and Diameters parallel to the Tangent. Half of this line is sometimes called the *Ordinate*, and the whole the double *Ordinate*.

— In an *Ellipsis*, is a right line drawn in an *Ellipsis*, from one side to another parallel to a Tangent, that passes through one of the Ends of that Diameter to which it is an *Ordinate*.

— In an *Hyperbola*, is a right line drawn in an *Hyperbola* from one side to the other, and divided into two equal parts by the indeterminate Ax of the *Hyperbola*.

*Oriens*, the East Point where the Sun rises when he is in the Equinoctial Points *Aries* and *Libra*; but serves indifferently for all that part of the Horizon in which the Sun rises to us at any part of the Year. Hence

*Oriental*, Eastern.  
*Orion*, a Southern Constellation.

*Orthogonal*, Right-angled.  
*Orthodromie*, when a Ship runs in a right line.

*Orthography*, is the Representation (in Architecture) in a Model of one of the Faces

ov.

OX

Faces of a Building, according to the Proportions it is design'd to be built in; See also Profile.

*Oval* : See *Ellipsis* for the plane Figure, and *Spheroid* for the Solid.

## *Ouranography, a Description of the Heavens.*

*Outaconfticon, an Ear-pipe,  
to augment hearing.*

Oxygen, } an Acute an-  
Oxygenium, } gled Triang-  
gle.

P. A.

P A

**P**arabola : See the End  
of this Dictionary for  
Conick Section.

*Parabolism*, is the Division of the Terms of an Equation by the known Quantity ( when there happens to be one ) that is involved or multiplied into the first Term. Thus the following Equation

$$2xx + 2abx = bcc$$

will be reduced to bcc  
this  $xx + 2bx = \underline{\hspace{2cm}}$ .

*Paraboloid*, is a Solid formed by the Circumvolution of a Parabola about its Axis. This is otherwise called a *Parabolick Conoid*.

Parallax, is the difference between the true Place of a Planet, and its apparent one. It is evident that this difference or Parallax will be greatest when the Pla-

net is nearest to the Earth, and consequently the Horizontal Parallax will be the greatest, *i. e.* when the Planet is in the Horizon.

Whence it follows that when a Planet is vertical, it will have no Parallax, because its true and apparent Place will agree.

The Angle also which is formed in the Center of a Planet by two lines imagined to be drawn from the Center of that Planet to the Surface of the Earth, and to the Center of the Earth is called the *Angle of Parallax*, and commonly the *Parallax*.

The *Parallax* is moreover divided into the *Parallax of Altitude*, which is the difference between the true and apparent Height; and into *Parallax of Latitude*, which is the difference between the true and apparent Latitude;

tude; and into *Parallax of Right-ascension*, which is the difference between the true and apparent Right-ascension, and into the *Parallax of the true and apparent Declination*, which is the difference between the true and apparent Declination; and into the *Moon's Parallax to the Sun*, which is the *Excess of the Parallax of the Moon above that of the Sun*.

It is evident, according to *Riccioli*, that the Parallaxes of Height, Longitude, Right-ascension may be *Eastern and Western, Northern and Southern*.

The Horizontal Parallax, is when the Sun or Moon is in the Horizon. It is evident this will be the greatest of all.

*Parallel* lines, are lines that always keep an equal distance from one another.

— Circles on the Globe, are the Circles of Latitude, which are Parallel to one another, and to the Equator.

— *Sphere*, is that Position of the Sphere, which has one Pole in the *Zenith*, and the other in the *Nadir*, and the Equinoctial line in the Horizon.

*Parallelogram*, is a Quadrilateral or Four-sided Figure, the opposite sides whereof are parallel. This Name is a common Genus for the *Square, Oblong, Rhombus, and Rhomboid*.

*Parallelepiped*, is a Prism or Solid terminated by six Parallelograms, whereof the two opposite are like, and parallel and equal.

*Parallelopleura*, any Figure may be so called that has two parallel sides.

*Parameter*: See *Conick Sections* at the End of the Dictionary.

*Parapet*, is an Elevation of Earth cast up to cover the Soldiers from the Enemies Cannon. Its Thickness is commonly 18 or 20 Foot, and its Height 6 Foot on the side of the Covert way, and 4 or 5 on the side of the Campaign.

*Paraselene*, a Mock-moon.  
*Parhelion*, a Mock-sun.

*Part*, is a less Quantity compared with a greater.

— *Aliquot and Aliquant*: See the Letter A.

— *Proportional*, a Part that bears any Proportion to its whole.

*Pendulum*, a Weight hung by a string, which by its Motion describes Archs of a Circle, which some make use of to measure time. Also the Name of a sort of Clocks.

*Peninsula*, a part of Land environed almost round by Water.

*Pentagon*, a Figure that has five sides.

*Pentaspalt*, an Engine consisting of five Pulleys, *viz.* three

three above and two below.

*Perigaeum*, or *Perigee*, when a Planet is in its nearest Distance, or least distant from the Earth, it's said to be in its *Perigaeum* or *Perigee*.

*Perihelion*, when any Planet is nearest to the Sun, it is in its *Perihelion*.

*Perch*: See the Appendix of Measures.

*Period*, a certain Number of Years, or Revolutions of the Planets, &c. are so called.

*Periaci*, those who inhabit under the same Meridian, and under the same Parallel; but not under the same Semi-circle of the Meridian, but on the opposite, and so they have one of the Poles between them in that Hemisphere.

*Perimeter* and *Periphery*, the Circumference of any Figure.

*Perisctii*, are those who have their Shadows cast on all sides the same day, that is, their Shadows go round them in a Day. Such are the Inhabitants of the frigid Zone.

*Periptere*, a Place environed with Pillars without.

*Peristyle*, a Place full of Pillars round about within side.

*Perpendicular*, a line insiting on another at Right-

angles, is called by this Name. In common Mechanick uses, it is called a Plumb-line.

*Perseus*, the Name of one of our Northern Constellations.

*Perspective*, is the Art of representing Objects in a Draught, as naturally as they would appear through the Plate, if it were transparent.

*Phases* (appearances) of the Moon and Planets, are those enlightened Parts of them which they shew to us.

*Phenix*, the Name of one of the Southern Constellations.

*Phænomena*, are (in Astronomy) the appearances in the Heavens, or the Observations of what happens there; and as such are the Foundations of the various Astronomical Hypotheses.

*Phosphorus*, (the bringer of light) is the Name of *Venus*, when she is the Morning-star.

*Piedestal*, or *Pedestal*, the Foot or Basis any thing stands on.

*Pilasters*, are square Pillars which have the same Measures, Chapitels and Bases as other Pillars according to their respective Orders.

*Pilot*, an Officer on Board a Ship

P L

Ship that takes care to steer it in and out of Harbours in safety.

*Pinnace*, a small sort of Ship.

*Pisces*, one of the twelve Signs of the Zodiack, the last in our Order of Reckoning.

*Plane*, is a Surface all the Parts whereof lie equally between its Extremities, insomuch that no one is higher or lower than another.

— *Hemisphere*, is one half of a Map of the World, which contains one half of the Earth.

*Planisphere*, the whole Globe or Sphere of the Earth projected in *Plane*; or a whole Map of the World is so called.

*Planimetry*, the Art of measuring Surfaces or plain Figures.

*Planets*, Wandring Stars; we commonly count seven, viz. Saturn, Jupiter, Mars, the Sun, Venus and Mercury, and the Moon. The Copernican System exempts the Sun, and puts the Earth in its Room.

*Plain-scale*, a thin Ruler about a Foot in length, whereon are graduated a line of Chords, Leagues, Rhumbs, &c.

— *Chart*, a Plat or Chart that Sea-men sail by, whose Degrees of Longitude and

P O

Latitude are made of the same length.

— *Sailing*; is sailing by the Plain-chart.

*Plintbus*, ( in Architecture ) is a flat Square which serves for the Foundation of the Base of Pillars.

*Point*, the beginning of Magnitude, which is conceived so small as to have no parts.

*Poles of the World*: The two Ends of the Axis or Right-line about which the Sphere is conceived to move or turn, are called its Poles; the one whereof is called Arctick, the other Antartick, q.v.

— of a Circle on the Sphere; are two Points on the Surface of the Sphere equally distant from the Circumference of that Circle; and because there are always two such Points diametrically opposite, it follows that every Circle on the Globe has two Poles; and a line drawn from one to the other through the Globe, will pass through the Center of that Circle. Thus the

— of the Equator, are the Poles of the World, and — of the Horizon, are the Zenith and Nadir.

— of the Zodiack or *Ecliptick*, are 23 Degrees and a half distant from the Poles of the World. — of

— of a Dial: All Dials whatsoever are Horizontal Dials in some part of the Earth, and the Zenith and Nadir of that Horizon are the Poles of that Dial.

Polar Circles, the Arctick and Antarctick, are so called.

— Star, is in the Tail of the *Ursa Minor*, so called; as being not above two Degrees and a half distant from the Pole, and seems to the naked Eye as if in the same Place.

Polyedrum,  $\{$  a Solid or Polyedrons Solid,  $\}$  Body terminated by several Right-lined Planes.

Polygon, a many angled Figure.

Polynomials, Quantities composed of several Monomials, joined together by the Signs + or — as a + b + c + d, &c.

Polympast, an Engine consisting of several Pulleys.

Pontus Euxinus, the Name of a Sea.

Ponton, a great flat Bottom'd Boat.

Porism, is a general Theorem, according to Proclus, found out by means of, and drawn from another Theorem already demonstrated.

Poristic, a Method which determines how, and by what way, and after how

many ways a Problem may be resolved.

Powers of Numbers or Algebraick Quantities, are Products of the same Quantity multiplied by it self ad infinitum. Thus the 2d. Power is called the Square, the 3d. the Cube, the 4th. the Bi-quadrat, &c.

— in Mechanicks is any thing that is applied to any Engine, to move therewith any weight; as Men, Horses, Water, Wind, &c.

Preparation of Equations, is the Reduction of them, or making them fit either to solve Analytically, or by Geometrical Construction.

Prime Numbers, are those which have no other common Measure besides Unity; as 8 and 15, &c.

Primum Mobile, the ninth Heaven according to Ptolemy so called, because it carries along with it by its Motion the Inferior Heavens.

Principles, in Sciences are common, or self-evident Notions; in Mathematicks there are reckoned three sorts, Definitions, Axioms, and Postulates.

Prism, is a Solid terminated by more than 4 Planes, whereof two are opposite, like, equal and parallel, and the others Parallelograms.

— Triangular, is that whereof the two opposite

site Bases are Triangles like, parallel and equal.

*Problem*, is a Proposition which proposes something to be done; as to divide a line into any Number of given Parts; to draw the Periphery of a Circle through three Points given.

*Profile*, (in Perspective) is an Orthographick Projection in a plane Parallel to a vertical Plane.

*Progression*, is a Consequence or Train of Quantities which follow one another, and keep a certain Reason or Proportion among themselves, each of these Quantities are called Terms. *Progression* is either

— *Arithmetical*, which is a Consequence or Train of Numbers in Arithmetical Proportion, q. v.

— *Geometrical*, which is a Train of Numbers in Geometrical Proportion, q. v.

*Projection of the Sphere*, is a describing of the Lines and Circles of the Sphere, or so many of them as the purpose requires, in *Plano*, or on a flat Surface. Thus Maps, Astrolabes, Sun-dials, Quadrants, &c. are Projections of the Sphere.

— *Orthographick*, is the Representation of an Object on a Plain, to which Perpendiculars are conceived to be drawn

from all the Points of the Object.

— *Astronomical*, is the Representation of the Circles of the Sphere upon the Plane of a great Circle of that Sphere, or a plane Parallel to it. There are 3 Sorts, viz. *Stereographick*, *Orthographick*, and *Gnomonical*.

— *Stereographick*, is that wherein the Eye is supposed to be in the Pole of the *Circle of Projection*. In this Projection there are only those great Circles which are perpendicular to the Plane of Projection which are represented by right lines, the others both great and little are represented by Circles. By this Projection *Astrolabes* and *Planispheres*, which are the Projection of the Sphere upon the Plane of a great Circle of that Sphere, &c. are made.

— *Orthographick*, is that wherein the Eye is supposed at an infinite Distance from the *Circle of Projection*, wherein by Consequence all the visual Rays are parallel among themselves, and perpendicular to the *Circle of Projection*. This Projection serves also for the Construction of *Astrolabes*, &c.

— *Gnomonical*, is that where the Plane of Projection is parallel to a great Circle of the Sphere, and where the

the Eye is in the Center of the Earth. The great Circles of the Sphere are represented in this Projection by Right-lines, and the little ones by Curve-lines which are always some one of the Conick Sections.

*Prometheus or Hercules,* the Name of a Constellation.

*Promontory,* a Mountain or considerable Height which jets out into the Sea; as the Cape of Good Hope, &c.

*Proportion,* which some confound with *Reason*, is a Similitude of Reasons, which by Consequence may be either *Arithmetical*, *Geometrical* or *Harmonical*.

— *Arithmetical*, is a Similitude of Arithmetical Reasons. Thus we know that these four Numbers, 2, 5, 8, 11, are in Arithmetical Proportion, because the Arithmetical Reason of 2 to 5, is the same as that of 8 to 11, the Excess in each being 3.

— *Geometrical*, or *Analogy*, is a similitude of Geometrical Reasons. Thus these four Numbers 2, 3, 4, 6, are in Geometrical Proportion, because there is the same Reason of 2 to 3, as of 4 to 6, each being *Subsequalternan*.

— *Harmonick*, is that wherein the first Term is to

the last in a Geometrick Reason equal to that of the difference of the two first, to the difference of the two last. Thus these three Numbers 2, 3, 6, are in Harmonick Proportion, because the first 2, is to the last 6, as the difference of the two first, viz. 1 is to the difference of the two last, viz 3. Thus also these four Numbers 2, 3, 6, 12, are in Harmonick Proportion, because the first 2, is to the last 12, as the difference of the two first 1, is to the difference of the two last 6.

— *Continual*, is where the mean Terms are both Antecedents and Consequents, as 2, 6, 18, 54, are in continual Geometrical Proportion, because not only 2 is to 6, as 18 to 54, but also as 6 is to 18, and by Consequence as 18 to 54. Likewise these four 3, 5, 7, 9, are in continual Arithmetical Proportion, because the Excess of each is 2.

— *Discontinued*, or *Interrupted*, is that where the mean Terms are not both Antecedents and Consequents. Thus this Proportion 2 : 4 :: 3 : 6, is a Geometrical discontinued one; for tho' 2 be to 4, as 3 to 6, yet 2 is not to 4, as 4 to 3. Thus also this Arithmetical Proportion 2 : 5 :: 7 : 10, is discontinued;

continued; for although 5 be as much greater than 2 as 10 is than 7, yet 5 does not exceed 2 by the same Excess as it is exceeded by 7. Hence it also appears that a discontinued Proportion can't have less than four Terms.

— *Rational*, is when one of the two Equal Reasons is Rational; as  $2:3::4:2$ , and also  $\sqrt{2}:\sqrt{8}::\sqrt{3}:\sqrt{12}$ , which are both Geometrical.

— *Irrational*, is when one of the two Equal Reasons is irrational, as  $2:\sqrt{6}::\sqrt{6}:\sqrt{15}$ .

— *Alternate*, is when we compare the Antecedents of two Equal Reasons the one with the other, and also the Consequents; as if there is the same Reason of 2 to 3, as of 4 to 6, then by *Alternate Proportion*, there will be the same Reason of 2 to 4, as of 3 to 6.

— *Inverted*, is the comparing the Consequents with the Antecedents; as if there is the same Proportion of 2 to 3, as of 4 to 6; then you conclude *Invertendo*, that there is the same Reason of 3 to 2, as of 6 to 4.

— by *Composition of Reasons*, is the comparing of the Antecedent and Consequent taken together to the Consequent alone, as if there is

the same Proportion of 2 to 3, as of 4 to 6, then *Compōnendo*, there is the same Reason of  $2+3$  or 5 to 3, as of  $4+6$  or 10 to 6.

— by *Division of Reason*, is the comparing the Excess of the Antecedent above the Consequent to the same Consequent; as if there be the same Proportion of 3 to 2, as of 12 to 8, then *Dividendo*, there is the same Proportion of 1 to 2, as of 4 to 8.

— by *Conversion of Reason*, is the comparing the Antecedents with the difference of the Terms; as If there be the same Reason of 2 to 3, as of 8 to 12, we conclude there is the same Reason of 2 to 1, as of 8 to 4.

— of *Equality orderly placed*, is when there are more than two Terms in each Rank; as if there were these three Numbers 2, 3, 9, in a Rank, and these three others 4, 6, 18, in another Rank proportional to the precedent one, so that 2 shall be to 3, as 4 is to 6, and 3 to 9, as 6 to 18; in this case you may cast away the middle Terms in each Rank, and conclude that the first 2 is to the last 9 in the first Rank, as the first 4 is to the last 18 in the second Rank.

— of *Equality disorderly placed*, is when there being three Numbers in one Rank, and three other proportional to the precedent in another Rank, you compare them in a different Order; as if there are in one Rank these three Numbers 2, 3, 9; and in another Rank these other three, *viz.* 8, 24, 36 proportional to the 3 precedent 2, 3, 9, in a different Order, so that 2 shall be to 3, as 24 to 36, and 3 to 9, as 8 to 24. Then you may also cast away the mean Terms in each Rank, and conclude that the first 2, in the first Rank is to the last 9, as 8, the first of the other Rank to the last 36.

*Proportional mean Geometrical*, is the second of three Geometrical Proportionals, or Quantities that are in Geometrical Proportion.

— *Mean Arithmetical*, is the second of 3 quantities that are in Arithmetical Proportion.

— *Mean Harmonick*, is the second in 3 Harmonical Proportionals.

— *Third and Fourth*, are the last of 3 or 4 proportionals.

nal Quantities in any of the aforesaid Proportions.

*Proportionality*, is a Similitude of Proportions.

*Proposition*, is any thing that is predicated of any Subject; whether true or false.

*Prostapheresis*, is the difference between the true and mean Motion of the Planets, which is to be added to, or subtracted from the mean Motion of the Planets to obtain the true, or to or from their true Motion to obtain their mean, and is thence accordingly called *additive*, or *subtractive*.

*Pyramid*, is a solid Figure, terminated by Triangles, and ending in a Point at the *Vertex* or *Top*, but its Base may be either a Triangle, and then it is called a *Triangular Pyramid*, or a Square, or a Polygon, &c.

— *Optick*, is the Figure which the Rays of Light prolonged from any Object through a Diaphanous Medium make to the Eye, where they end in a Point.

*Pyrotechny*, is the Art of making Fire-works.

## Q U

**Q** *Vadrant*, is the 4th Part of a Circle or 90 Degrees, and from thence the Name of an Instrument of great use among Mathematicians in Practical Geometry, Astronomy, &c.

— of Altitude is part of the Furniture of an Artificial Globe, being a thin brass Plate divided into 90 degrees, and marked upwards with 10, 20, &c. being rivetted to a brass Nut which is fitted to the Meridian, and has a Screw in it, to screw upon any Degree of the Meridian; when it is used it is most commonly screwed to the Zenith. Its use is for measuring the Altitudes, finding Amplitudes, and Azimuths, and describing Almicantarahs, &c.

*Quadratick Equations*, are Square Equations, whether pure as the simple Square, or affected as are the three other Sorts.

*Quadratrix*: See the End of this Dictionary.

*Quadrature of the Circle* is to find a Square (or any other Right-lined Figure) equal to the Area of a Circle; or a Right-line equal to its Circumference.

— of the *Parabola*, is to find a Right-lined Area equal to that of the Parabola, which was first done by Archimedes, who found that it was  $\frac{2}{3}$  of a Circumscribing Parallelogram.

— of the Moon; the first and third Quarters are so called.

*Quadrilateral Figure*, is any Right-lined Figure terminated by four sides.

*Quadrangle*, any Figure that has four Angles.

*Quadruple*, Four-fold or twice double.

*Quantity* whatever is susceptible of more or less, of Number or Measure, is called by this Name, and is distinguished into

— *Discrete* which is that whereof the parts are not united together by a common *Vinculum* or Band; as Number.

— *Continued* is that whereof the parts are knit or united together within some common Term or Terms; as Magnitude. It is moreover divided into

— *Successive*, as Time and Motion; or

— *Permanent*, as Extension into Length, Breadth and Thickness. *Quar-*

## QU

Quarters of the Moon when the Moon is distant from the Sun a Quarter of the Zodiac, or three Signs, which happens the 7th or 8th day, at which time she turns to us just half her illuminated part, then that *Phasis* is called the *First Quarter*.

When the Moon goes from thence to her opposition, and comes to be diametrically opposite to the Sun, so that our Eye is just between her and the Sun, and that consequently she shews us her whole illuminated part, then that *Phasis* is called *Full-moon* or *Opposition*.

Lastly, when the Moon goes on from her Opposition to her Trine Aspect, on-

## QU

wards to her *Conjunction*, she shews more than half of her illuminated Part, and then that *Phasis* is called the *Third* or last *Quarter* of the Moon. It is evident that the Moon has also the same *Phases* in *decreasing* as in *increasing*.

*Quintuple Five-fold*; as 15 is *Quintuple* of 3.

*Quinquangled*, a Figure that has five Angles; it is also called by the Name of *Pentagon*.

*Quotient*, ( a Term in Arithmetic ) in Division is how many times one Number is contained in another; as if 48 be to be divided by 6, which contains it just 8 times, then 8 is the Quotient in that Division.

## RA

**R**adius ( in Geometry ) the Semi-diameter of a Circle is so called.

*Random* ( in Gunnery ) the Angle of Elevation of the Piece is so called.

*Range*, ( also in Gunnery ) is the Distance the Piece carries or flings the Ball.

*Rational Quantities*, are those between which there

is any expressible Reason or Proportion: See *Irrational*.

*Rampart* ( in Fortification ) is a Work cast up of Earth round a Town.

*Ravelin*, the Name of an Outwork in Fortification.

*Ray*, a Beam of Light falling on any Object, which may be reflected or refracted, &c. q. v.

*Reason* ( in Geometry ) is the mutual Habitude or Relation or Comparison of two Magnitudes of the same kind to one another, in respect of their Quantity.

— *Mean and Extream*, a line is said to be divided in *mean and extream Reason*, when the whole line is to its greater part, as that greater part is to the less.

— *of Equality*, is that which is between two equal Quantities, as in Numbers of 2 to 2, 3 to 3, &c.

— *of Inequality*, is that which is between two unequal Quantities, as in Numbers of 3 to 6, or 6 to 5, &c.

— *Multiple*, is where the Antecedent contains the Consequent more than once exactly, thus

— *Double*, is when the Antecedent contains the Consequent twice, and its Denominator is 2; as the Reason of 6 to 3.

— *Triple*, is when the Antecedent contains the Consequent thrice, and its Denominator is 3, as the Reason of 12 to 4, &c. and so of the rest, as *quadruple*, &c.

— *Super-particular*, is when the Antecedent contains the Consequent once, and over and above an aliquot part of the same Consequent: And it is called in particular

— *Sesquialteran*, if that aliquot part above be an half, as the reason of 3 to 2. And

— *Sesquiterian*, if that aliquot part over and above be  $\frac{1}{3}$ , as the reason of 8 to 6. And

— *Sesquiquartan*, if it be  $\frac{1}{4}$ , as the reason of 15 to 12, &c. ad Infinitum.

— *superpartient*, is when the Antecedent contains the Consequent once, and moreover an aliquot part of the said Consequent: And if that aliquot part be for Example  $\frac{2}{3}$ , then the reason is called

— *Superbipartient-terian*, as the reason of 20 to 12, and if it be  $\frac{3}{4}$ , it is called

— *Supertripartient-quartan*, as the reason of 21 to 12; but if it be  $\frac{4}{5}$ , it is called

— *Super-quadrupartient-quintan*, as that of 9 to 5, &c.

— *Multiple super-particular*, is when the Antecedent contains the Consequent several times, and moreover an aliquot part of it: Thus if the Antecedent contain the Consequent twice, and moreover one half part of it, it is called

— *Double*

— *Double-sesquialteran*, as the reason of 15 to 6; if it contain the Consequent thrice, and moreover one third part, it is called

— *Triple-sesquiterian*, as the reason of 20 to 6: And if the Antecedent contain the Consequent 4 times, and moreover one fourth part of it, the reason is called

— *Quadruple-sesquiquartan*, as the reason of 17 to 4, and so of others.

— *Multiple-superpartient*, is when the Antecedent contains the Consequent several times, and moreover an aliquant part of the said Consequent: And if the Antecedent contains the Consequent twice, and moreover  $\frac{2}{3}$  of the same Consequent, the reason is called

— *Double-superbipartient-tertian*, as the reason of 8 to 3; and it is called

— *Triple-supertripartient-quartan*, if the Antecedent contain the Consequent thrice, and moreover  $\frac{3}{4}$  of it, as the reason of 15 to 4; and it is called

— *Quadruple-superquadrupartient-quintan*, if the Antecedent contain the Consequent four times, and moreover  $\frac{4}{5}$  of the said Consequent, as the reason of 24 to 5, &c.

— *Submultiple*, is when the Antecedent is contained exactly a certain number of times in the Consequent; and the reason is called

— *Subdouble*, when the Antecedent is contained exactly twice in the Consequent, as the reason of 3 to 6.

— *Subtriple*, when thrice, as the Reason of 2 to 6; And

— *Subquadruple* when four times; as the reason of 3 to 12; and so of others.

— *Subsuper-particular*, is when the Consequent contains the Antecedent once, and moreover an aliquot part of it, viz. of the said Antecedent; and if that aliquot part be  $\frac{1}{2}$  it is called,

— *Subsesquialteran*, as the reason of 2 to 3, and

— *Subsesquiterian*, if the aliquot part be a third as the reason of 6 to 8, and

— *Subsesquiquartan*, if that aliquot part be  $\frac{1}{4}$ , as the reason of 12 to 15, and so of others. And Reason

— *Subsuperpartient*, is when the Consequent contains the Antecedent once, and moreover an aliquant part of the said Antecedent; and if that aliquant part be for Example  $\frac{2}{3}$ , then the reason is called

— *Subsuperbipartient-tertian*, as the reason of 3 to 5; if it be  $\frac{3}{4}$  it is called

— *Subsupertripartient-quartan*, as the reason of 4 to 7; if the aliquant part be  $\frac{4}{3}$ , the reason is called

— *Subsuperquadrupartient-quintan*, as the reason of 5 to 9, and so of others.

— *Submultiple-superparticular*, is where the Consequent contains the Antecedent several times, and over and above an aliquot part of the said Antecedent; and if for Example the Consequent contains the Antecedent twice, and over and above  $\frac{1}{2}$  of the said Antecedent, then the reason is called

— *Subdouble-sesquialteran*, as the reason of 2 to 5; and

— *Subtriple-sesquitertian*, if the Consequent contain the Antecedent thrice, and moreover  $\frac{1}{3}$ ; as the reason of 3 to 10, and

— *Subquadruple-sesquiquartan*, if the Consequent contain the Antecedent 4 times, and moreover  $\frac{1}{4}$  part, as the reason of 4 to 17, and so onwards.

— *Submultiple-superpartient*, is when the Consequent contains the Antecedent several times, and moreover an aliquant part of the said Antecedent, and is called

— *Subdouble-superbipartient-tertian*, if the Consequent contain the Antecedent twice, and moreover  $\frac{2}{3}$  of the said Antecedents, as the reason of 3 to 8, and

— *Subtriple-supertripartient-quartan*, if the Consequent contains the Antecedent thrice, and moreover  $\frac{3}{4}$ , as the reason of 4 to 15, and

— *Subquadruple-superquadrupartient-quintan*, if the Consequent contains the Antecedent four times, and moreover  $\frac{4}{5}$ , as the reason of 5 to 24, and so of others.

— *Arithmetical Rational*, is that whereof the two Terms are rational; as the reason of 2 to 3.

— *Arithmetical Irrational*, is that whereof the two Terms are not rational; as the reason of 2 to  $\sqrt{3}$ , and the reason of  $\sqrt{2}$  to  $\sqrt{5}$ .

— *Geometrical Rational*, is that to which an equal one may be exhibited in rational Numbers; as the reason of 6 to 8, which is equal to that of 2 rational Numbers, and also the reason of the  $\sqrt{2}$  to the  $\sqrt{8}$ , which is equal to that of these two rational Numbers 1, 2.

— *Geometrical Irrational*, is that to which there cannot be assigned an equal one in rational Numbers; such

such is the reason of 2 to  $\sqrt{5}$ , and also  $\sqrt{5}$  to the  $\sqrt{6}$ : But the reason of the  $\sqrt{27}$  to  $\sqrt{12}$ , is rational, because 'tis equal to that of 3 to 2.

*Rectangle* or *Oblong*, is a Right-lined Figure consisting of 4 Sides, and 4 Right-angles; whence it is evident, that every Square is a Rectangle though not the contrary.

*Reclining* ( leaning back) Dials are so called, whose Planes lean back from a Perpendicular to the Horizon.

*Reduction of Equations* ( in Algebra ) is the reducing them into a fit and proper Order or Disposition for a Solution. There are 5 Ways or Rules made use of for doing this, *viz.* *Transformation*, *Antithesis*, *Hypobibasm*, *Parabolism* and *Isomeria*; which see in their proper Places.

*Reflexion* (in Catoptricks) is when a Ray of Light falling on any hard or polish'd Body is reflected or turned back into the Air in an Angle equal to that of its Incidence; or in general according to Monsieur Rohault it is the Change of the Determination of the Motion of a Body, which is effected by its meeting another, which it cannot penetrate.

*Reflux* of the Sea, which is also called its *Ebbing*, is when the Tide goes back, or the Water grows low.

*Reformation of the Calendar*: See *Style*.

*Refraction* is the Deviation of a Body, that passes obliquely from one Diaphanous Medium into another more or less thin, from that Right-line in which it would have continued to have moved had it not been for the resistance of that other Medium, which is the cause that the Body in the Continuation of its Motion deviates from its Rectitude. Thus a Ray of Light passing out of the Air into the Water, is refracted, &c.

— *Astronomical*, is a Refraction caused by the Atmosphere, whereby a Star seems risen higher above the Horizon than indeed it is. This Refraction is very inconsiderable after the Star is risen 45 Degrees above the Horizon.

— *Horizontal*, is that which makes the Sun or Moon appear just in the Horizon, when indeed they are below it.

*Regiment*, is a certain Number of Companies of Horse or Foot. They are not always alike in Number, and so cannot be justly determined; they are most commonly somewhat over or under 600.

*Region*, Upper Region of the Air, is that part of the Air

Air or Atmosphere which is above the Tops of the highest Mountains on Earth. It is more pure, thin and lighter than the lower ones, and free from Meteors and Exhalations.

— *Middle of the Air*, is that which reaches from the Tops of the highest Mountains down to our lowest Air which we inhabit.

— *Lowest*, is that which we inhabit, and which is limited by the reflection of the Sun-beams, or is supposed to reach as far as they are reflected back again.

— *Celestial*, is that vast Extent of the Universe, which contains all the *Host of Heaven*: The Sun, Moon and Stars, but sometimes for distinction sake that part of the *H a v n* wherein the Neighbouring Planets move, is called the *Planetary Region*.

*Regular Figures*, ( in Geometry ) are those whose Sides and Angles are equal.

*Residual*: See *Apotome*.

*Resolution*: See *Analytick*.

*Retrograde*, a Planet is so called, when it moves contrary to the Succession of Signs; as from the second Degree of Aries to the first, &c.

*Retrenchment*, is any work that covers a Post, and fortifies it against an Attack;

as Fafcines cover'd with Earth, Gabions, Bags of Earth, &c. and in general whatever covers the Muskeeters, while employ'd to stop the Progress of the Enemy.

*Revolution mean of a Planet in the Zodiack*, which in the Sun is called the *mean solar year*, is the return of the line of mean Motion of a Planet from any one Point of the Zodiack to the same Point again.

— *True of a Planet in the Zodiack*, which in the Sun is called the *true solar year*, is the Return of the line of the true Motion of that Planet from any one Point of the Zodiack to the same Point again.

*Rhombus* is a Quadrilateral Figure, which has all its Sides equal but not all its Angles.

*Rhomboid* is a Quadrilateral, which has only its opposite Sides and Angles equal.

*Rhumbs*, are the Points of the Compas, and sometimes the Road which a Vessel makes at Sea by following one of the Points of the Compas.

*Right-ascension*: See *Ascension and Descension*.

*Right-line*, is that which lies equally between its Points, or according to some, the shortest that can be drawn between two Points. *Right-*

## R O

## R U

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 Right-sphere : See *Sphere*.  
 Rood, is  $\frac{1}{4}$  of an Acre.

Root (in Arithmetick) is a Number considered in order to be multiplied once or more times by it self to make thereby Products called Powers.

Root-square, is such a Number considered, as in order to be but once multiplied by it self, as 4 is the Square-root of 16.

Cubick, is so called

in relation to a triple Multiplication of it self, as 4 is the Cube or Cubick-root of 64, and so onwards to Bi-quadratick, Sursolid, &c. ad Infinitum.

Rule (in Arithmetick) is the Canon or Method of resolving any Question, the different and particular kinds of which may be seen at large in Treatises of Arithmetick.

## S C

## S E

**S**agittarius, the Name of one of the Signs in the Zodiack, and thus characterized (Σ.)

Saturn, one of the Planets the most remote from the Sun ; according to some 79 times, and according to others 91 times bigger than the Earth.

Satellites, the small secondary Planets that move round Jupiter and Saturn are so called, the Moon likewise in the same sense is a Satelles or Satellite to the Earth.

Scalenum, or Scalene Triangle, is one that has all its three sides unequal.

Scenography, is the representation of an Object as of a Building, &c. in *Plano*.

Scheme, is the representation of any Figure on Paper, &c.

Scholium, is a Note or Annotation on any Subject or Proposition in Mathematics.

Sciography, the Art of Dialing or denoting the time of the Day by shadows.

Scorpio, one of the twelve Signs of the Zodiack thus characterized (♏.)

Seasons of the year are 4, viz. Spring, Summer, Autumn, Winter.

Secant of an Arch or Angle,

gle, is a Right-line drawn from the Center of that Arch through one of its Ends till it meet another line called a *Tangent*, q. v.

*Second*, in time is the 60th part of a Minute, it is likewise the 60th part of a Degree of a Circle.

*Sector* of a Circle is a part of a Circle comprehended under two *Radius* or Semidiameters, which are supposed not to make one right line, and a part of the Circumference. Whence it may be either less or greater than a Semi-circle.

— of a *Sphere* is a Conical Solid whose Vertex ends in the Center of the Sphere, and its base is a Segment of the Sphere.

*Sections Conick*: See the End of the Dictionary.

*Segment of a Circle*, is a part of a Circle terminated by a right-line less than the Diameter, and by a part of the Circumference.

— of a *Sphere*, is a part of a Sphere terminated by a part of the Surface of the Sphere, and by a Plain that cuts it through any part except the Center. Whence it is evident that the Plain which is the Base of such a Segment, is a Circle the Diameter whereof is less than that of the Sphere, and consequently that it is

always either less or greater than an Hemisphere.

*Semi-circle*, is one half of a Circle terminated by the Diameter, and half the Circumference.

*Semi-diameter*, is half the Diameter of any Figure, but mostly called by that Name, in Circles and Spheres.

*Selenography*, is a Description of the Face of the Moon as distinguish'd by Spots, and Prominencies, visible by help of a Telescope.

*Septangled Figure or Heptagon*, is a Figure that has 7 Angles.

*Septentrio*, The North.

*Septentrional*, of or belonging to the North.

*Serpent*, the Name of a Constellation in our Northern Hemisphere.

*Serpentine-line*: See *Spiral*.

*Sexagenary Arithmetic*, is that which proceeds by sixties, as the Division of Circles, Time, &c. into Degrees, Minutes, Seconds. &c.

*Sextant*, the sixth part of a Circle, there is an Instrument so called.

*Sicily*, the Name of a Country.

*Signs Astronomical*, are the 12 Signs in the Zodiack, viz. *Aries*, *Taurus*, *Gemini*, *Cancer*, *Leo*, *Virgo*, *Libra*, *Scorpio*, *Sagittarius*, *Capricornus*, *Aquarius*, *Pisces*.

— *Algebraick*, are these following, + which signifies *more*, or that the Quantities between which it stands are to be added. — Which denotes *Subtraction*, x denotes *Multiplication* — be-

— *a* *tween two Letter*, as —

*b* denotes *Division*, as *a* to be divided by *b*,  $\sqrt[2]{}$  denotes a *Square-root*,  $\sqrt[3]{}$  a *Cube-root*, &c.

*Signifer*. Sometimes the *Zodiack* is so called; as *having*, or *carrying* the 12 *Signs*.

*Similar Figures*, are those whose respective Angles are equal to one another, and their sides proportional

*Sine, Right of an Arch or Angle*, is a right-line drawn from one of the Extremities of that Arch perpendicular to the Diameter which passes through the other Extremity of the same Arch. Whence it follows that a Right-line belongs always to two Arches, which taken together make a Semi-circle or 180 Degrees. It is also evident that the greatest of these Sines will be the right Sine of one Quarter of the Circle, or 90 Degrees, wherefore it is called the *whole Sine*, and also *Radius* as being the true *Radius* of the Circle.

— *Versed of an Arch or*

*Angle*, when the Arch or Angle is less than 90 Degrees, is that part of the Diameter which is comprehended between the Arch and the Right-line. It is evident that a *versed Sine* is always less than the whole Sine, when the Arch is less than a *Quadrant*, and greater when the Arch is greater than a *Quadrant*; because in this case the *versed Sine* is equal to the *Sum* of the *Radius* and *Right-line* of the *Complement* of the Arch, and in the other the *versed Sine* is equal to the *Excess* of the *Radius* above the *Sine Complement*.

— *Complement of an Arch or Angle*, is what that Arch or Angle wants of 90 Degrees, or what it is greater than 90 Degrees when it exceeds them. Thus the *Complement* of an Arch or Angle of 40 Degrees is an Arch or Angle of 50 Degrees, and the *Complement* of an Arch or Angle of 120 Degrees, is an Arch or Angle of 60 Degrees.

*Sirtes*, are *Sands* under *Water*, which lying not deep enough for the *Vessels* to sail over them, they are often cast away on them.

*Sol, the Sun.*

*Solar year*, is the time the Sun employs in going thro' the *Zodiack*, which is about

365 days, 5 hours, 49 Minutes, 16 Seconds. It is something longer in finishing the *Solar Astral year* which is the space of time it employs in returning to the same Star again it left at the beginning.

*Solstice*, is when the Sun Enters the Tropical Points, where he seems for some days to be at a stand; There are 2; the Summer Solstice when the Sun Enters Cancer the 21<sup>st</sup> of June making the longest day and shortest night; and the Winter Solstice on the 21<sup>st</sup> of December when he Enters Capricorn the nights being then at longest and the days at the shortest.

*Solid*: See *Body*.

*Solid number*, is so called by way of analogy, and is any 3 Numbers multiplied by one another.

*Solidity* of a Body is the Number of little determinate solid Measures that it contains. Those measures are commonly little Cubes, &c.

*Solution* is the answering any question proposed.

*Species, specious Algebra*, is the Modern Algebra which is practised by Species, or forms of things, denoted by letters of the Alphabet, which are of great help to the Imagination to retain different kinds of things

distinctly, which in only Numbers could not be done without a great deal of trouble, and continual danger of Confusion.

*Speculum* is the surface of an opaque body, well polish'd, and consequently capable of reflecting the Sun beams falling on it; They are called either plain, or Spherick, &c. according to their form

*Sphere or Globe* is a Solid conceived to be formed by the Circumvolution of a Semicircle round about its diameter, which for that reason is called the *Ax*. of the Sphere, &c.

*Sphere-right, &c.* See *Right, oblique, &c.*

*Spheroid* is conceived to be formed by the Circumvolution of a Semi-ellipse about one of its *Axis*. It's simply called a *Spheroid* or sometimes an *oblong Spheroid* if the Circumvolution be performed about the longest *Ax*, but if about the shortest it is called a *prolate Spheroid*.

*Spiral* may be conceived by this formation of it: Let A be the Center and AB the Semidiameter of a Circle BCDE. Imagine the Radius AB to be moved about the Center A by an Uniform Motion, through all the points of the Circumference BCDE, from B to C; and at the same

same time Conceive a point to be carried from the Center A towards B upon the same Radius AB by an uniform motion, inasmuch that in as many equal parts as the Circle is divided by the Semidiameter AB, into so many equal parts also shall the Semidiameter AB be divided by the point which goes from the Center A; the same point by its twofold Motion from A to B and to C will describe the Curve A 3 6 9 B, which is called a *Spiral* or *Helix*, whereof *Archimedes* has written a Treatise; we will only here add that a Spiral describ'd by one entire Circumvolution is called the *First*, the *Second* being that which is made by a second entire Circumvolution of the Radius AB, while the point which goes from the Centre A continues to move in the same time beyond B, by a Motion always Uniform, &c.

*Square* is a right lined figure consisting of 4 Equal sides, and as many right angles.

*Square number*, is any number multiplied by it self as 16 is the Square of 4.

*Square Equation*: Vid. *Quadratick Equation*.

*Station of a Planet*, is when a Planet seems to stand still for some time in the

same degree of the Zodiack  
Stadium is a measure in Geography which Contains 125 Geometrical paces.

*Staticks* is a Science which teaches the knowledge of *Weights*, of *Centres of Gravity*, and the *Equilibrium*, of natural bodies.

*Stereography* the Art of describing or laying down the Representations of Solids, as houses, &c.

*Stereometry* is the Art of measuring solid Bodies, or finding their Solid Contents.

*Stratarithmetry* the Art of drawing up any Number of Soldiers in any figure or form required.

*Style*, the Gnomon of a Dyal.

*Stylobata* the Pedestal of a Column or Pillar in Architecture.

*Sublunary under the Moon*.

*Subtraction* is the Invention of a Number equal to the difference of 2 Numbers given of the same kind. It may be either *Simple* or *Compound*.

— *Simple* is the way of taking one number out of another greater of the same species.

— *Compound* is the way of taking a sum Compounded of several different species from another Sum compounded likewise of the same sorts of Species.

*Subtense*: See *Chord*.

*Superficies* or *surface* is an *Extension* which has *length* and *breadth* without *depth*.

*Supplement* any addition that is made to supply something deficient before.

*Surds*: See *Irrational quantities*.

*Sursolid* the fifth power from any given Root either in *Species* or *Numbers*.

*Symbol* is a sign of any thing. In algebra *Symbols* are signs which denote *Addition*, *Substraction*, &c. as  $+$  more or to be added — less or be substracted;  $\times$  denotes to be multiplied; —

a

between two letters, as —

b

denotes  $a$  to be divided by  $b$ , and  $\sqrt{2}$ ,  $\sqrt[3]{3}$ ,  $\sqrt[4]{4}$ , &c. the Root, Square root, Cube root, Biquadratick roots.

*Symmetry* Proportion.

*Synthesis* is the Method of demonstrating Propositions from their first Principles, or predemonstrated propositions, which afterwards are of Equivalent authority with Principles, till you come to the last, or Conclusion that was to be demonstrated.

*Syphon* a Curve Tube thro' which water or any liquor beginning to run will run till all is Exhausted without any other force than the natural pressure of the Air; but it must be noted that the Air's pressure will not force the water to ascend above 30 or 32 foot perpendicular height.

*System* (in Astronomy.) The *System of the world* is the Order wherein the Planets move round the Earth, or round the Sun.

*Syzygia* Conjunctions or oppositions of the Stars.

**T**ables of *Sines*, *Tangents* and *Secants*; are numbers proportional calculated from and depending on the given quantity of the Radius or whole

Sine in a Circle, from whence any other Sine, &c. may be found. Their chief use is for Trigonometrical Calculations.

— *Astronomical* are Tables

bles of the Celestial Motions.

— *Loxodromick*, are Tables which serve for the easie and ready Solution of Problems in Navigation.

*Tangent* of an Angle or Arch of a Circle, is a Right-line drawn from one of the Extremities of the Arch perpendicular to the Diameter which passes through the same Extremity, and terminated by the Meeting of another Right-line drawn from the Center through the other Extremity of that Arch; it is called a Tangent because it touches the Arch of the Circle in a Point; it belongs to two Arches, which together are equal to 180 Degrees, or a Semi-circle.

*Taurus*, the second Sign of the Zodiack characteriz'd thus (♉.)

*Telescope*, a Prospective-glass; or two Glasses or more placed in a Tube of varions Lengths for observing Objects at a Distance; its chief Use is for Astronomical Observations.

*Temperate Zone*: See *Zone*.

*Term*, is the Extremity of any Magnitude.

— of a *Progression*, is each Member of the Progression.

— of an Equation, is any of the Members of that Equation.

*Terra firma* the Continent, is sometimes called by this Name.

*Terrella*, Load-stones, are sometimes so called, especially when cut round.

*Tetrachord*, a Musical Instrument consisting of four Chords.

*Tetraedrum*, one of the five Regular Bodies; an Equilateral Pyramid.

*Tetragonal*, of or belonging to a Square.

*Tetragonism*, the Quadrature or Squaring of any Curve.

*Thaumaturgick*, any Art that does or seems to do Wonders.

*Theodolite*; an Instrument for surveying Land.

*Theorem* ( in Mathematics ) is a speculative Proposition, which examines the Properties of things, and wherein something is proposed to be demonstrated.

*Theories of the Planets*, are Hypotheses or Suppositions of the Celestial Motions, according to which ( being supposed as established ) Astronomers explain the reasons of the *Phænomena* or Appearances of the Planets.

*Theorbo*, a Musical Instrument.

*Thermometer*, a Tube of Glass filled with Spirit of Wine or Quick-silver to shew the Degrees of Heat and Cold.

I To-

*Topography*, a Description of any small Place on the Earth without regard to the Situation of its Parts towards the different Parts of the Heaven; as of *London*, and its Suburbs, *Paris*, &c.

*Torrid Zone*: See *Zone*.

*Transformation* of an Equation, is the changing of any Equation into one more easie.

*Transposition*, is the placing of any Member of an Equation on the contrary side of the Sign of Equality under a contrary Sign; as suppose  $xx + b = c$ , by transposition you'll have  $xx = b - c$

*Transom*, the Vane of a Cross-staff.

*Trapezium*, a square Figure, whose four Sides and Angles are not equal.

*Triangle*, a Figure that has three Sides and three Angles.

*Trigonometry*, is the Art of measuring Triangles whether Right-lined or Spherical; or an Art that shews how from any 3 things given, *viz.* Angles and Sides, or Sides (but not 3 Angles alone) to find the rest, *viz.* the other An-

gles or Sides: See the Appendix to this Dictionary.

*Triglyphs* (in Architecture) are the Ends of Joists which fasten in or fill their Corresponding Holes.

*Trilateral*, any Figure or thing that has three Sides.

*Trinomial*, a quantity consisting of three Names or Parts, as  $a + b + c$ , &c.

*Triones*, seven Stars in the *Ursa Minor*, are called by that Name.

*Triple*, Three-fold.

*Triplast*, an Engine consisting of three Pulleys.

*Trochilike*, the Art of Wheel-work.

*Tropicks*, are two Circles equally distant from the Equator, *viz.* 23 Degrees and one half; whither the Sun being arriv'd returns again towards the Equator; so that they are the Bounds of its Motion towards the North and South.

*Tropick of Cancer*, is that towards the *Ardick Pole*, which is our Tropick, and the

— of *Capricorn*, is that which is towards the South Pole.

*Tuscan Order*: See *Order*.

# V E

**V**ane: See *Transform*.  
**Variation of the Needle**, Is the turning or deviation of the Needle in the Mariner's Compass, more or less, in all places from the true North. Or more properly, it is the Angle which the Needle makes with the true Meridian-line drawn thro' the Center of Motion of that Needle. This Variation is from the North to the **East or West**; whence it is distinguished into *Oriental* and *Occidental*. It is *Oriental*, i. e. the Needle declines towards the East, when the Northern Point of the Needle, i. e. (commonly) the *Flour-de-luce* does not turn towards the true North of the World, but deviates towards the East. On the contrary it is called *Occidental*, when it deviates towards the West.

— of the Variation, it is so called, because that Variation is not always the same in the same Place, but varies in process of time from what it was.

**Venus**, one of the Planets nearest to the Sun except Mercury.

# V I

**Versed Sine**: See *Sine*.

**Vertex**, the Top of any thing or Figure is so called. Whence

**Vertical**, any thing that relates or belongs to the Vertex of any thing, particularly a Star is said to be *vertical* that happens to be just over any place. So also the Equator is vertical to them who enjoy a perpetual *Equinox*, &c.

**Vesper**, the Evening.

**Vespertine**, belonging to the Evening; also when a Planet sets after the Sun, &c. it is so called.

**Vessel**, Ships are often called by this Name.

**Via lactea**, the Milky-way: See *Galaxy*.

**Vibrations**, the Swings of Pendulum's are so called: See *Pendulum*.

**Viol**, { Musical Instruments, whereof the first has 7, the second 4 Chords or Striags.

**Virgo**, one of the Signs of the Zodiack, the 6th in order.

**Vision-direct**, is when the Rays of Light come from the Object directly to the Eye.

— *Refracted*, is when they pass through different Mediums.

— *Reflected*, is when they are reflected from any Body to the Eye.

*Umbilicus*: See *Conick Sections* at the End of the Letter C.

*Unit*,  $\Sigma$  is one, or any *Unity*,  $\Sigma$  thing conceived as indivisible, or without Part.

*Unison*: See *Monochord*.

*Universe*, the whole Mass of Material Beings, as Heavens, Earth, Stars, &c. are called by that Name.

*Vortex*, a Whirl-pool in the Sea or Rivers. *Des Cartes* supposed the Planets to be carried round in such a Whirl-pool of liquid *Aether* or Celestial Matter. But the Motion of the Planets can no ways agree with that of any *Vortices* whatsoever. Mr. *Newton* has demonstrated that the Motion of the latter must necessarily be performed in *Ratione Duplicata*, or as the *Squares* of the Distances of the Parts from the Centre, but the Planets are carried in *Ratione Sesquialtera*. Therefore, &c.

**W**atch, a Sea-phrase, signifying four Hours, they measure it by a Glass, whose

Sand is four Hours running out.

*Winter-solstice*: See *Solstice*.

**Y**acht, a small Vessel, whose Use is chiefly for Pleasure.

is a great Circle which divides the Heavens into two Hemispheres, and is intersected by the Equator, and other Circles parallel to it, which divide the Heavens into five Parts, called Zones, or Temperate Zones.

**Z**enith, is the Vertical Point just over our Heads.

**Z**ero, a word sometimes used (particularly among the French) for a Cypher, or (0.)

**Zetrick**, is a Method made use of to solve Mathematical Problems; or it is the way of finding by what means or steps one may fall into an Analytick Trace to find a Solution.

**Zodiack**, is a great Circle which goes sloping between the two Poles of the World, which is cut at Oblique Angles by the Equator at  $23\frac{1}{2}$  Degr. at the beginning of the Signs *Aries* and *Libra*. In it are the 12 Signs.

**Zone**, the two Polar Circles, and the two Tropicks divide the Heavens into five Parts called *Zones*, viz. the *Torrid* which being terminated by the two Tropicks has 47 Degrees of Breadth. The *Northern Temperate Zone* under which we inhabit, which being terminated by the *Tropick of Cancer*, and the *Artick Polar Circle* has 43 Degrees of Breadth, and the *Southern Temperate Zone*,

which is also 43 Degrees of Breadth, and the *Southern Temperate Zone* which is terminated by the *Antartick Polar Circle* has 47 Degrees of Breadth, and the *Southern Frozen Zone*, which being terminated by the *Antartick Polar Circle* has 47 Degrees of Breadth. These last the Sun never comes to.

**Zones**, are also reckoned five on the Earth, terminated by Circles parallel to one another; viz. by the two *Polar Circles*, and by the two *Tropicks*, which divide the Earth into 5 Zones or Parts; one *Torrid*, two *Cold*, and two *Temperate ones*, which have their Names from the Qualities of the Places they enclose. The

**Torrid**, is terminated by the two *Tropicks*. It is in the Middle of the two *Temperate ones*, and is divided by the *Equator* into two equal Parts, the one *Northern*, the other *Southern*; it is 57 Degrees broad, or about 3420 Miles.

This Zone is called *Tor-*

rid, because being just under the Sun's Road, his Beams fall directly on it, and cause excessive a heat that the Ancients believed it to be uninhabitable.

Those who inhabit just under the Middle of this Zone, having their Zenith in the Equator enjoy a perpetual Equinox, the Sun never going above 23 $\frac{1}{2}$  Degrees from their Zenith.

Their longest Day is 13 Hours and one half, and their shortest 10 $\frac{1}{2}$ ; and the Sun in their Winter is but 47 Degrees from their Zenith.

They have five different Shadows, one *Western* when the Sun rises, *Eastern* when it sets, *Northern* when it is in the Southern Signs, and *Southern*, when in the Northern; and *perpendicular* at Noon.

Frigid are two; and terminated by the two *Polar Circles*, one takes in the *North*, the other the *South*.

*Pole*. They have a great inequality of Day and Night; the Sun appears above their Horizon sometimes several Months. They are excessive cold. They as well as the Torrid Zones were esteem'd uninhabitable by the Ancients. But later Navigations have discovered several Inhabitants beyond the Polar Circles, as Part of *Norway*, *Sweden*, and *Muscovy*, &c.

Temperate, are also two; which lie between the Torrid and two Frigid ones; they contain each 43 Degrees of Breadth. That which is between the *Antarctic Polar Circle*, and the *Tropic of Cancer*, which we inhabit, is called *Northern*, the other *Southern* in respect of us.

*Zophorus*, (in Architecture) is a part between the *Architrave* and *Corniche*. It was so called by the *Grecians*, by reason of the Ornaments which were cut thereon, among which were *Animals*.

# *An Appendix.*

## A Short IDEA OF Practical plain Trigonometry: OR, THE Cases of Plain Triangles.

WE have given the Definition of Trigonometry in its Place under the Letter T. We will now present the Reader with a short *Synopsis* of the Proportions for solving all the Cases, as far as necessary; and for Memory sake reduce the thirteen Cases to four Rules; but first we will premise some things necessary to be known, in order to the more perfect Understanding them.

1. In every Triangle there are six Parts, *Viz.* three Sides, and three Angles, any three whereof being given (except the three Angles) the other three may be found by a Trigonometrical Calculation,

2. In any Triangle the three Angles taken together are equal to two right ones; wherefore having

any two given the third is known of course, by subtracting the sum of the given ones from 180 degrees.

3. In a Right-angled Triangle, where one Angle is a right one, the other two are necessarily acute, and both together =  $90^\circ$ . wherefore one is always the Complement of the other to a Quadrant.

4. In a Right angled Triangle, if one of the Legs of the Right angle be made the Radius of a Circle, the Hypotenuse will be the Secant of the adjacent Angle, and the other Leg the Tangent. But if the Hypotenuse be made Radius, the Legs will be the Sines of their opposite Angles.

5. In all Triangles the Sides are proportional to the Sines of their opposite Angles. These two last Articles are commonly taken for Axioms in Trigonometry.

And in the latter of them is founded our first Rule, which is general, and extends both to right and oblique angled Triangles, wherein we use only Sines, and is as follows.

## **RULE 1.**

**R U L E . I.**

1. *If a Side be sought, you must begin from that given Angle which is opposite to the given Side, and say;*

*As the Sine of the given Angle ( opposite to the given Side )*

*To the opposite Side*

*So the Sine of the other given Angle ( opposite to the Side sought )*

*To the Side sought.*

2. *But if an Angle be sought, you must begin from the given Side which is opposite to the given Angle, and say;*

*As the given Side ( opposite to the given Angle )*

*To the Sine of its opposite Angle ( or the Angle sought )*

*So the other given Side ( opposite to the Angle sought )*

*To the Sine of the opposite Angle ( or the Angle sought )*

This Rule solves Eight of the Thirteen, viz. Five of the Right-angled, and three of the Oblique-angled, as may be seen in the following Process, and is called the Rule of opposite Parts.

**I. In Right-angled Triangles.**

**Opposite Parts**

Part given :: sought :: Proportions :

$ab, LL.$	$be$	$s, e : ab :: s, a : be.$
$ab, LL.$	$ae$	$s, e : ab :: s, a : ae.$
$ab, ae.$	$LL$	$ae : s, b :: ab : s, e$
$ab, ae.$	$be$	$1' ae : s, b :: ab : s, e.$
$ab, ae.$	$be$	$2' s, e : ab :: s, a : be.$
$ae, LL.$	$ab$	$s, b : ae :: s, e : ab.$

**R U L E 2.**  
Where there are not opposite Parts enough given, which happens in two Cases of Right-angled Triangles ; wherein if

1. A Side be sought the Proportion runs thus :  
As Radius  
To the Tangent of the Angle (opposite to the Side sought,) So the given Leg To the Leg sought.
2. If

2. If an Angle be sought, the Proportion is this;

As the Leg adjacent to the Angle sought  
To the other Leg opposite to it,  
So is Radius  
To the Tangent of the Angle sought.

given      sought      Proportions.

$ab, be$	$LL$	$ab : be :: R : T$
$ab, be$	$ac$	$1' \text{ as above}$ $2' s, a : b :: s, b : ac$

2. In Oblique-angled Triangles

RULE 1.

$be, ae, a$	$b$	$be : s, a :: ae : s, b$
$be, a, ae$	$ab$	$be : s, a :: ae : s, b \text{ then}$ $s, b : ae :: s, a : ab$
$a, b, ae$	$be$	$s, b : ae :: s, a : be.$

RULE 3.

## R U L E 3.

To be used when there are given two Sides with the Angle intercepted.

As the Sum of the Sides is

To their Difference,

So the Tangent of half the Sum of their unknown Angles

To the Tangent of half their Difference.

Sum of the Sides	Half the Sum	Half the Difference
100 : 62 : 38	51 : 19	19 : 11
100 : 62 : 38	51 : 19	19 : 11
100 : 62 : 38	51 : 19	19 : 11
100 : 62 : 38	51 : 19	19 : 11

Sum of the Sides	Half the Sum	Half the Difference
100 : 62 : 38	51 : 19	19 : 11
100 : 62 : 38	51 : 19	19 : 11
100 : 62 : 38	51 : 19	19 : 11
100 : 62 : 38	51 : 19	19 : 11
100 : 62 : 38	51 : 19	19 : 11

0, 08, 08	$\alpha, \alpha$	$08 + \alpha : 08 = 08 : \frac{1}{2} \times L.L. \text{ opp. } T, \frac{1}{2} \times L.L. \text{ opp. } \left\{ \begin{array}{l} \text{to the greater} \\ \text{opp. c.} \end{array} \right.$
0, 06, 06	$\alpha$	$\text{Then } \frac{1}{2} \times L.L. = \frac{1}{2} \times L.L. \left\{ \begin{array}{l} \text{not be less.} \\ \text{a.} \end{array} \right.$  Find the other Angle by the preceding Proportion, then $s, \alpha : 06 :: s, 0 : \alpha.$

## RULE 4

When three Sides are given.

bc, bd, cd

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cd : cb + bd :: cb - bd : cb

As the greatest Side is  
 To the Sum of the other two,  
 So is their Difference  
 To the Difference of the Segments of the Base.

That is, make the greatest Side the Base, to which from the opposite Angle let fall a Perpendicular, which shall divide the Base into two Segments, the least whereof  $de$ , if it be subtracted from the greater  $ce$ , will leave  $bc$ , the Difference of the Segments of the Base, which is found by the Rule above. If the Difference  $bc$ , be subtracted from  $cd$ , there remains  $bd$ , the half of which  $ed$ , is the less Segment, which if it be taken from  $cd$ , there remains  $ce$ , the greater Segment.

By these Means the Triangle is divided into two others, which are solved by the Cases of Right-angled Triangles above.

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# Conick Sections;

OR,

## The Primary Properties of the three Sections of a Cone briefly Exhibited and Demonstrated.

Suppose the Cone BAC be cut by a Plane DE, parallel to the Side AB : the Section thereby made will be a Parabola.

From *Euclid* it is evident, that in any Circle the Rectangle of the versed Sines is equal to the Square of the Right-line.

I. In a Parabola the Rectangle of the Latus Rectum, and intercepted Ax is equal to the Square of the Ordinate.

$BD \times DC$  is = to the Square of the Right-line in the Circle, or = to the Square of the Ordinate of the Parabola; for the Right-line of the Circle, and the Ordinate are equal to one another in the same Circle.

Make  $ED : DC :: FE (= NO = BD) : L$  ; This line L is that which Mathematicians call the *Latus Rectum*.

ED;

$ED : DC : EO : OP$ , by reason of similar Triangles. And

$FE : L :: EO : OP$ , by reason of equal Reasons. Hence

$$FE (= NO) \times OP = L \times EO.$$

But  $NO (= FE) \times OP =$  to the Square of the Versed-sine, and consequently to the Square of the Ordinate of the Parabola; therefore  $L \times EO =$  Square of the Ordinate. Q. E. D.

See the Scheme relating to this Page.

$ED$  is the Axis of the Parabola,

$EO, EO, \&c.$  are the intercepted Axes,

$OR, OR, OR, DS$ , the Ordinates.

2. In a Parabola the Squares of the Ordinates  $DS, OR$ , are proportional to the intercepted Axes  $ED, EO$ .

By the precedent Prop.  $\left. \begin{array}{l} ED \times L = DS^2 \\ EO \times L = OR^2 \end{array} \right\}$

$$\frac{ED \times L}{EO \times L} = \frac{DS^2}{OR^2}$$

And dividing ..  $\frac{ED}{EO} = \frac{DS^2}{OR^2}$

Viz.  $ED : EO :: DS^2 : OR^2$

That is ..  $ED : EO :: DS^2 : OR^2$ . Q. E. D.

Any line RP parallel to the Ax ED, is called a Diameter.

A Parabola.

2. In a Parabola the Rectangle of the Diameter, and Latus Rectum, is equal to the Rectangle of the Segments of the double Ordinate; viz:

$$RP \times L = TP \times PS$$

Draw OR parallel to the line DS.

$$\left. \begin{array}{l} ED \times L = DSq \\ EO \times L = ORq \end{array} \right\}$$

$$\text{Then } ED \times L - EO \times L = DSq - ORq$$

$$\text{That is } ED - EO \times L = DSq - ORq.$$

$$\text{Viz. } RP (= DO = ED - EO) \times L = DSq - (ORq = ) DPq.$$

$$RP \times L = DSq - DPq$$

The Difference of the two Quantities multiplied into their Sum, gives the Difference of their Squares.

The Sum of DS and DP is TP; and the Difference of DS and DT is PS;

Therefore  $DSq - DPq = TP \times PS - RP \times L$  as before, and  $TP \times PS = RP \times L$  Q. E. D.

## An Ellipse.

Suppose the Cone ABC to be cut obliquely by a Plane DA, the Section thence arising will be an Ellipse.

1. In an Ellipse: As the Axis to the Latus Rectum, so is the Rectangle of the Parts of the Axis to the Square of the Ordinate.

$IO \times OK$  is always equal to the Square of the Ordinate of the Ellipse.

Make as  $AD : AC :: ED : L$  the Latus Rectum.

By reason of similar or like Triangles  $AD : AC :: OD : OK$ ;

And because of like reasons  $ED : L :: OD : OK$

$$L \times OD$$

$$ED$$

By reason of like Triangles  $AD : ED :: AO : ED \times AO$

$$IO - \frac{AD}{ED \times AO}$$

$$OK \times IO = L \times OD \quad ED \times AO$$

$$L \times OD \times ED \times AO \quad L \times OD \times AO$$

$$ED \times AD \quad AD$$

= to the Square of the Ordinate,

$$L \times OD \times AO$$

$$Then OK \times IO = \frac{AD}{L \times OD \times AO}$$

$$AD$$

And

And,  $AD : L :: OD \times AO : \text{Square of the Ordinate}$  Q. E. D.

*A Hyperbola.*

Suppose the Cone ABC, cut by the Plane DF, meeting BA, when produced in the Point E; the Section thereby made will be an Hyperbola.

*In an Hyperbola as the Transverse Diameter is to the Latus Rectum. So is the Diameter + part of the Ax multiplied into the same part of the Ax to the Square of the Ordinate. That is,*

$ED : EF (= ED \times DF) \times DF :: L : \text{Square of the Ordinate};$  That is,

$ED : L :: EF \times DF : \text{Square of the Ordinate}.$

PD is supposed parallel to BC;

Make  $DF : PD :: FC : L$

*Viz.*  $DF : FC :: PD : L$

$$DF \times L = FC \times PD$$

$$DF \times L$$

$$\text{and } \frac{ED}{PD} = FC$$

PD

$ED : PD :: EF : BF$ , by reason of Sim. Triang.

$$PD \times EF = BF \times ED$$

$$PD \times EF$$

$$\frac{ED}{ED} = BF$$

ED

$$\frac{DF \times L}{FC \times BF} = \frac{PD \times EF}{PD \times ED} \times \frac{ED}{L}$$

K 2

L x

$$\frac{L \times EF \times DF}{ED} = \text{to the Square of the Ordinate.}$$

That is,  $ED : L :: EF : DF$ : Square of the  
Ordinate; Q.E.D.

ED:EF (= ED $\times$ EF)  $\times$  DE : I :  $\frac{1}{2}$  dose  
of type O antigenic; Type is

ED:R:EExDE:Shares of the Originals

PD is fully committed to BC

W<sub>12</sub> BE:BD:HC:LT

$$DE \times F = BC \times BD$$

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FC

100 100 100

THE EPIPHANY

PD\*EE

ED 100 BB

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# MECHANICKS.

WE have given you the Definitions and Descriptions of the six Principles of Mechanicks, or the six simple Machines under their respective Letters; we will now shew the Reader how by one single Proportion to solve all their Forces, and determine their Powers, except that of the *Caneus* or *Wedge*, which as depending on other Principles, we shall not here insist particularly on to explicate of its Powers. It is true, some endeavour to reduce it to a double Leaver, and thence explain its Force, but the Doctrine of *Percussion* being likewise concerned in it, it would be here too prolix, as well as too intricate, to treat of it.

In the first Place therefore in all the other Machines, we will denote the Power or Force that moves them by the Letter (*a*), the Weight or Thing to be moved by the Letter (*b*), the line of Motion wherein the Power moves we will call (*c*), and the line wherein the Weight moves (*d*). Then this Proportion solves all their Forces, viz.

$$a : d : : b : c$$

That is, this Proportion makes an Equilibrium; so that expressing the Weight and Force by lines in the same Proportion, the Rectangle *dc*, will

be equal to the Rectangle  $ca$ : This is Universally true in all Machines possible, wherein the Weight and Force are continuous, or move by continued intermediate Lines. We will now explain it in the five Machines receiv'd, as Principles, which move by such Motion.

1. *Libra.* For the *Libra* or Balance; suppose the Line or freight Beam  $az$  to be a Balance. If the Centre of its Motion or *Fulcrum* be  $f$  in the first, the Line  $a$ , being always equal to the Line  $c$ , it follows that only equal Weights, or equal Power and Weight, will make an Equilibrium.

2. In the second the Distance  $sf$ , being double to  $zf$ , and proportionably in any other Proportion of Distances. (Arches of Circles being in the same Proportion as their Radii) consequently  $c$ , double of  $a$ , the Power or Weight in  $a$ , must be but half of that in  $c$ , to make an Equilibrium.

2. *Vestis* or *Leaver*; that *Vestis* admits of a triple Variation, because *Leaver* the Power may be conceived to move the Weight after three ways, or by three different Applications, as may be thus seen.

1. In one kind (which for distinction sake we will call the first) the *Fulcrum* or ( $f$ ) is underneath, the Weight ( $b$ ) at one end, and the Power ( $a$ ) at the other.

2. In another (or the second kind) the *Fulcrum*  $f$ , is at one End, the Power  $a$ , at the other, and

and the Weight  $b$ , in any of the intermediate Points.

3: In a third kind the *Fulcrum*  $f$ , is at one End, the Weight ( $b$ ) at the other, and the Power ( $a$ ) in some of the intermediate Points.

Before we proceed to any other, we will hint at some of the common Instruments among many others made use of, that are explicable by these two Principles.

1. By the first sort of *Libra* (or the *Balance*) is explained the common sorts of Scales made use of by Tradesmen, wherein may be noted as a Corollary of this Doctrine, that if the Centre of their Motion or *Fulcrum* be not exactly in the middle, by putting the Weight into that Scale which is on the longest Side of the Beam, they will give you less than your true Weight.

2. By the second sort of *Libra*, you may explain the Method of weighing things with the *Stilliard*, &c.

3. By the first sort of *Vestis* or *Leaver*, in the first Place you have the common way of lifting, or moving Weights by Iron-Crows, &c.

In the second Place, supposing two such *Leavers* fastned together by their *Fulcrums* or *Centre of Motion* (as ab, and 1, 2.) and you have the reason of cutting things with Shears and Scissars, &c.

In the third Place, by the same sort of *Vestis* or *Leaver*, (having a moveable *Fulcrum*) is explained the Reason and Force of rowing Boats, &c. with Oars, Skulls, &c.

4. By the second sort of *Vestis* or *Leaver* may be explained another way of using a *Crow*; and

also when the Weight is in the middle, the reason of the Pulleys drawing up Weights, by a Power that shall be to the Weight, but little more than as 1 to 2.

5. By the third and last kind of *Vertis*, may be explained the way of Country-men's lifting up heavy Trusses of Hay, &c. in order to load them on their Forks, &c. wherein they make use of their Foot as a *Fulcrum*, and the nearer they place their Hand to the Weight, the easier they always find it to lift, as if the Weight be 54*l.* and the Hand be placed 9 times nearer the Weight than the Foot or *Fulcrum*, the Weight will be to the Hand but the 9th Part of the real Weight, that is but 6*l.*

But to proceed to the next Principle we design in order to treat of, viz. the *Trochlea* or *Pulley*.

3. By what we have already said, the *Trochlea*, or *Pulley*. Force of the *Trochlea* or *Pulley* may be explained, which is nothing else but a Complication of Infinite Leavers of the second Kind, all joined in a Wheel, e.g.

The upper Pulley 1, 2, 3, which is commonly fastened on an immoveable Centre as 2, only represents a Balance with the Centre of its Motion (2) in the Middle, and so neither augments nor diminishes the Force, but only serves to facilitate the Motion.

In the lower Pulley (a) is the Power, (b) the Weight placed always in the middle of one of the (Infinite Leavers) of, whence it is evident that (af) being to (bf) as 2 to 1, the Power a = 1, will be in *Equilibrio* with the Weight b = 2;

so that every lower Pulley diminishes half the Weight, and so onwards when more are made use of, *ad Infinitum*.

Hence also as a *Corollary* may be explained, the Force of tooth'd Wheels, which indent one into another, whereof the first takes off half the Weight, the second half the Remainder, &c. *Ad Infinitum*.

4. In the next Place we shall consider the *Axis in Peritrochio or Winlace*.

Wherein *c,c,c, &c.* is the way or line of the Power (*a*), and *d,d,&c.* of the Weight; wherefore by our General Proportion above the Force is determined.

This might also be explained by a Complication of (Infinite) Leavers of the second Kind; as suppose the Line or *Radius* of the Winlace 1, 2, to be (1) or an Unit, and the line *of*, or Radius of the Wheel (*of*, as sometimes, of the Handle) to be 4, that is, the Distance of the Weight from the *Fulcrum* 1, and from the Weight to the Power or Force 2, then the Force of 1 Pound in *a*, or *c*, will be equi-ponderant to 3 Pounds in *b*; and so in any other Proportion.

5. In the fifth and last Place for the *Cochlea, or the Screw*; suppose the Distance between any two *Spiræ* or Threds of the Screw to be 1, and the Distance of the Leaver (*of*) that turns the Screw, (for Screws are always turned by Leavers) from the Screw to be 30, then will the way or line of Motion of the Weight

Weight be as 1, and that of the Power as  $99\frac{1}{7}$  years; wherefore a Force equal to  $1\frac{1}{7}$ , will be in *Equilibrio* with  $99\frac{1}{7}$  l. near; and consequently a Force never so little greater than 1, will screw up the Weight, &c. And,

Thus we have in short shewn the first Principles of *Mechanicks* (omitting the *Cuneus* or *Wedge* as hinted before) from one Universal Principle, or general Proportion; whence all others possible, that can be contrived or moved by continuous intermediate Matter, may be solved also; as likewise all Machines complicated or compounded of these Principles; wherein that which was the Power or moving Force before becomes respectively a Weight, and so onwards by a continual Diminution of the Weight, *ad Infinitum*.

## A Quadratrix, &c.

**D**escribe within the Square ABCD the quadrant Arch of a Circle BD from A, one of the Angles of the Square, as its Centre; then conceive the Semi-diameter AD to move from D towards B, round its Centre A, by an Uniform Motion, through all the Points of the Circumference BD, and conceive also at the same time the Side CD, to move from C towards B in an Uniform Motion keeping always parallel to its Opposite Side AB, in somuch that as many equal Parts as the Arch BFD is divided into by the Radius AD, into so many also shall the Side BC be divided by the Side CD, which in this Case will be divided successively by the Radius AD, in Points

Points which will compose a Curve line DHE, which we call a *Mechanical Quadratrix*, because it serves for a Mechanical Quadrature of the Circle. Thus for Example when the Radius AD is come to the Point E of the third Division, the Side CD will be come to the Point G of the third Division also, beginning from D, and those two lines in that Situation will intersect one another in the Point H of the *Quadratrix*.

Thus likewise all the other Points may be found except the Point E, of AE, the Base of the *Quadratrix*; because when the Radius AD falls upon AB, the Side CD will fall also upon AB, which hinders the two lines AD, CD from intersecting one another, and consequently thereby prevents the finding the Point E.

You may easily perceive by the Figure, that one may find as many Points of the *Quadratrix* DHE by the Rule and Compass as you please, except the Point E, which can't be found but by Tentation or Trials, otherwise the Circle would be squared Geometrically, because the Base AE, the Radius AB, and the Arch BFD are lines in continual Proportion, as is demonstrated by *Pappus*, *Prop. 26. lib. 4.* and also by *Clavius*, and several others.

### A Spiral.

Suppose A to be the Centre, and AB the Semidiameter of the Circle BCDE. Conceive the Radius AB to be carried about the Center A, by an Uniform Motion through all the Points of the Circumference BCDE, from B towards C; and imagine at the same time a Point to move, or to be carried from the Center A, towards B, on the

same Radius AB, by an Uniform Motion; so that into as many equal Parts as the Circle is divided by the Semi-diameter AB, into as many equal Parts also shall the same Semi-diameter AB be divided by the Point which goes from the Center A; this Point by its double Motion from A towards B, and towards C will describe the Curve-line A<sub>369</sub>B, which is called a *Spiral* or *Helix*, whereof Archimedes has composed a particular Treatise, wherefore we shall omit to treat of it any further here; and only acquaint you that the *Spiral* describ'd by one entire Circumvolution is called the first *Spiral*, the second *Spiral* being that which would be described by a second entire Circumvolution of the Radius AB, while in the mean time the Point which goes from the Centre A, should continue at the same time to move on beyond B, by a Motion always Uniform, &c. and yet

*A Cycloid.*

Suppose a line AB be drawn perpendicular to another line CD, and round the said line AB describe a Circle, which must be conceived to roll along the line CD from A to both Ends, until B, the End of the Diameter AB, comes by descending to the Points C and D, in which Case the Right-line CD will be equal to the Circumference of the Circle. Then the Extremity B will describe by its Motion the Curve-line CBD, which is called a *Cycloid*, the Invention of which is attributed to Mersennus, and which has several pretty Properties, some whereof we will here briefly exhibit.

If you draw to any Point of the Cycloid E, a Tangent FG, that Tangent will be parallel to the correspondent Chord BE of the generating Circle.

2. If

2. If through the Point  $F$  taken in the Cycloid at discretion, you draw parallel to the Base  $CD$ , the Right-line  $EF$  terminated in  $E$ , by the Circumference of the *generating Circle*, that line  $EF$  will be equal to the correspondent Arch  $EB$ , of the same *generating Circle*, &c.

*A Cissoid.*

By the *generating Circle* we understand, that which by its Motion, or any other ways serves for the Description of the Curve-line. Such is the following Semi-circle  $ABE$ , which with the line  $CE$ , which is perpendicular to the Diameter  $AC$ , contributes to the Description of the Cissoid  $AFBD$ ; for if you draw any Right-line  $AH$ , which cuts the *Cissoid* in  $F$ , and the Circumference  $ABC$  in  $G$ , the part  $GH$  will be equal to the part  $AF$ .

From this Essential Property there follow several other Properties, which we have elsewhere shewn, and shall here only just mention.

1. The perpendicular  $CE$  is an *Asymptote* to the *Cissoid*; that is, it continually approaches nearer and nearer to the *Cissoid*, when those two lines are prolonged, without ever coming so near as to touch it, insomuch that those two lines will approach to a Distance less than any assignable Quantity.

2. The *Cissoid*  $ABD$  cuts the Circumference  $ABC$  in its middle Point  $B$ ; so that the Arches  $BC$  and  $AB$  are equal, or each a quarter of the Circle.

3. If through the Point  $F$ , where the Right-line  $AH$  cuts the *Cissoid*, you draw the Right-line  $IK$  perpendicular to the Diameter  $AC$ , the Arches  $BK$ ,  $BG$  shall be always equal, and the four lines  $CI$ ,  $IK$ ,  $AI$ ,  $IF$  will be continually proportional;

portional; which was the Reason the Ancients made use of the Cissoid to find two mean Proportionals between any two lines given.

But the Learned have rejected that Solution, because the Problem being only solid, it may be resolved by a line more simple; viz. by one of the first Gender, while the Cissoid is a line of the second, as is evident by its local Equation, which is this  $y^3 = axx - xxy$ , making  $AC = a$ ,  $IF = x$ , and  $AI = y$ .

This local Equation  $y^3 = axx - xxy$  being reduced into this,  $xx = \frac{y^3}{a - y}$ , shews that the Cissoid ABD, has an Asymptote, and that that Asymptote is the Perpendicular CE; for in the Fraction

$\frac{y^3}{a - y}$  which is equal to the Square  $xx$ , sup-

posing  $y = a$ , that is, that the line AI shall be equal to the Diameter AC, in which Case the Point I, will co-incide with the Point C, and the Perpendicular IF with the Perpendicular CE, the Divisor  $a - y$  will become equal to a, or infinitely small,

which will make the Fraction  $\frac{y^3}{a - y}$ , or  $xx$ , and

consequently x infinitely great, that is to say, that the line IF or CE, will become infinitely great; whence it may be easily concluded that the Cissoid cannot meet the Perpendicular CE, but at an infinite Distance, that is to say, that it will never meet with it or touch it, and that consequently the Perpendicular CE is the Asymptote of the Cissoid ABD.

4. If you draw the Chord AK, the four lines AI, IF, AK, AF will be Proportionals; also the four lines AC, CH, AK, AF; because the four lines AC, CH, AI, IF are proportional by reason of the similar Triangles ACH, AIF.

5. The reason of the two lines AC, AI to one another is equal to that of the two Squares CH, AF, and the line AF is a mean Proportional between CH, and IF.

The two lines AG, FH are equal, as also AG, CK, whence it follows that also these three are equal, viz. AG, FH, CK, and also these two AL, CL, and likewise these three LF, LG, LK. From these different Theorems may be drawn as many different Constructions of the Cissoid, among which any one may chuse the most simple and easie.

Lastly, The indefinite Space terminated by the Cissoid ABD, by its Asymptote CE, and by the Diameter AC, is triple of the generating Circle.

It is evident that the Cissoid is a regular Figure.

#### A Conchoid.

But the Conchoid both Superior EFG, and Inferior HIK, is irregular, and have a common Asymptote CD, as may be seen by their Generation, which is thus.

Suppose CD to be given by Position, as likewise the Point A. Conceive the Center of a given Circle L, to move along the line CD, having the same Plane with that which passes through the given Point A, and through the given line CD; conceive also at the same time a Right-line as AE, to move about the Point A, which passing through the Center L of the generating Circle, will cut its Circumference in certain Points as E, H, which will de-

scribe

scribe by the different Intersections made by the continual Motion of the line AE, and the generating Circle, the two Conchoids EFG, HIK, whereof the line CD will be the common Asymptote, which is also called the *Directrix*, and the fixed Point A, the Pole of each Conchoid.

When the line AE by its Motion about the Pole A, is come perpendicular to the Directrix CD, which Nicomedes calls the *Norma*, that is, when it is come to AF, you'll have at the two Points F and I the Top of the Conchoid, the common Ax, QII, whereof IF is equal to the Diameter HE of the generating Circle.

If, from any Point of the Superior Conchoid as E, you draw the Right-line EM perpendicular to the Directrix CD, and make EL = a, AB = b, BN = x, and EM = y, you'll have this local Equation  $y^4 + 2by^3 - aayy + bbyy + xxyy - 2aabyy - aabb = 0$ , which shews that the Superior Conchoid is a line of the second Gender.

In like manner, if, from the Point H taken at discretion in the Inferior Conchoid HIK, you draw the Right-line HN perpendicular to the Directrix CD, and make LH = a, AB = b, BN = x, and HN = y, you'll have this local Equation  $y^4 - 2by^3 - aayy + bbyy + xxyy + 2aabyy - aabb = 0$ , which shews that the Inferior Conchoid HIK, is also a line of the second Gender.

The Ancients made use of this line for the *Duplication of the Cube*, that is, to find the Side of a Cube double of a given one; which was needless, because that Problem being only solid, ought not to be resolved by a line of the second Gender.

# APPENDIX,

## Of Weights, Measures, &c.

### Measures of Length.

Three Grains of Barley Dry and Round make an Inch :  
Tis called in Latin *Uncia*, and sometimes in English,  
a Thumbs-breadth.

12 Inches make a Foot.

3 Feet a Yard, the 16th part whereof, viz. 2 Inches and  
 $\frac{1}{4}$  is called a Nail of a Yard.

A Yard and a Quarter makes an Ell, that is to say, 3  
Foot 9 Inches.

Five yards and an half, ( that is, 16 Foot and an half )  
make a Rod, Pole, or Perch, Statute Measure; But the  
Geometrick Perch or Gad, is 10 Feet, and in some places  
but 9 Feet.

Forty Perches in Length, and 4 in Breadth, make an  
Acre of Land; a Quarter of which, is called in some Places  
a Rood.

For all this, See the Statute 33 Edw. I. de Terris  
Mensurandis.

40 Poles or Perches, make a Furlong.

8 Furlongs, viz. 320 Rods, make a Mile.

This is likewise Settled by Act of Parliament. See  
the Stat. 25 Eliz. An Act to restrain New Build-

ings, &c.

So that in an English Mile there are

320 Rods,

5280 Feet,

And 63360 Inches.

**A League,** Is a Measure commonly reckoned at Sea, and contains three English Miles.

Besides these, there are some other Measures of Longitude; as,

**A Fingers-breadth,** [ called in Latin *Digitus* ] containing 2 Barley-Corns Length, or . laid side to side.

**An Hand-breadth,** [ *Palmus*, or *Palmus Minor* ] Three Inches.

**A Span,** [ *Spithana*, or *Palmus Major* ] 3 Hands-breadth; or 9 Inches

**A Cubit,** Half a Yard, or 2 Spans, being Counted from the Elbow to the Top of the Middle-Finger.

**A Step,** [ *Gradus*, or *Passus Minor* ] Two Feet and an half.

**A Stade,** [ *Passus*, or *Passus Major* ] Two Steps, or 5 Feet; from these the Romans Counted their Mile, calling it *Milliarium*, that is *Mille passus*, a 1000 Paces; but your English Mile you set before, is 56 Paces more.

**A Fathom,** Six Feet.

### Of Liquid Measures.

These amongst us in England, are varied in their Contents according to the several Liquors they are to Measure; As,

1. For Beer-Measure, 35 Cubical Inches and a Quarter make a Pint

Two Pints, a Quart.

Two Quarts, a Pottle.

Two Pottles, a Gallon.

Nine Gallons, a Firkin.

Two Firkins, a Kilderkin.

Two Kilderkins, a Barrel, in which, ( it appears from hence, that ) there are 36 Gallons, *wit.* 144 Quarts, *viz.* 288 Pints, *viz.* 1032 Cubical Inches in a Barrel.

2. For Ale-Measure, the Pint, Quart, and Gallon, are the same as in Beer-Measure; but there are allowed but 8 Gallons to the Firkin, 16 to the Kilderkin, and only 32 to the Barrel; so that a Barrel of Ale is to hold

hold but 128 Quarts, *viz.* 256 Pints, *viz.* 9024 Cubical Inches.

3. In Wine-Measure, there are but 29 Cubical Inches in a Pint, 2 Pints to a Quart, 4 Quarts to a Gallon, 18 Gallons to a Hogshead, three Hogsheads and an half, or 63 Gallons make an Hogshead; one Hogshead and a third part of an Hogshead, that is to say, 84 Gallons, make one Terce of Wine, that is the third part of a Tun; a Terce and an half, or 126 Gallons make a Pipe or Butt, and 2 Pipes or Butts a Tun of Wine, which contains 252 Gallons, *viz.* 2016 Pints, *viz.* 58212 Cubical Inches.

A Barrel for Soap is 31 Gallons.

### Dry Measures.

The Gallon for Dry Measures as Corn, &c. is less than the Beer and Ale Gallon, and greater than the Wine Gallon, containing 272 Cubical Inches and a Quarter, and divided into Pottles, Quarts, and Pints, as aforesaid.

Two of these Gallons make a Peck.

Two Pecks a Tovet, or Half Bushel.

Two Tovets, or 8 Gallons, a Bushel.

4 Bushels a Strike, or Coom.

2 Strikes a Quarter.

### Of Weights.

#### 1. Of Apothecary's Weights, and their Characters.

Thus mark'd.

A Grain gr. the least Measure or Weight of a Barley-Corn.

A Scruple s. Contains 20 Grains.

A Dram d. is 3 Scruples.

An Ounce oz. is 8 Drams.

A Pound lb. Contains 12 Ounces.

2 Stm's Half.

Other Signs used by Physicians, Chymists, &c. &c.

An Handful [ *Manipulus* ] thus noted — M.

A Pugil being as much of Herbs or the like, as can be taken up at once between 2 Fingers and one's Thumb, is thus marked — P.

Ana [ that is as much as to say, of Each a like Quantity ] A. or Ana.

Recipe, — Rx

Semissis [ half ] ss

Tartar — □

Sal — ⊕

Sulphur — △

Antimony — ⊖

Vitriol — ⊖

Our other Common Weights are Two-fold.

1. *Troy Weight*, whereby Bread, Gold, Silver, Apothecaries wares, as aforesaid, &c. are weighed: Containing only 12 Ounces in the pound, Each ounce 20 Penny-Weight, Each penny-weight 24 Grains. This seems to have been the most ancient Weight by its Name, as derived from the Famous City of *Troy*, from whence *Brutus* and his People are said to have descended, and to have Called *Landon, Troy-Novant, or New-Troy*.

2. The second and more common Weight, is called *Averdupois*, being fuller and larger Weight than the other; for it contains 16 Ounces, or 128 Drams, viz. 384 Scruples, viz. 7680 Grains: by this, are weighed all kinds of Grocery ware, and base Metals, as Iron, Copper, and Brass, as also Hemp, Flax, Rosin, Pitch, Tarr, &c.

The hundred Weight is not exactly what it seems to be by the word, but 112. to the Half Hundred, 56 pounds, the Quarter 28, and the Half Quarter 14 pounds.

Wool

*Wool Weights.***A Stone** 14 pounds.**A Tod** 20 pound.**A Sack** is 26 stone, that is 364 pound.*Cheese Weights.***A Clove** of Cheese is 8 pound.**A Wey** of Cheese 32 Cloves, that is 256 pound.And so much is the Wey of *Suffolk* Cheese, and the like is, or should be, the Barrel of *Suffolk* Butter.But the Wey of *Essex* Cheese is but 136 pounds, and their Barrel of Butter the same.Herrings are allow'd 120 to the Hundred, and ten Thousand of them are called *A Last*.*Characters in Astronomy.**The Planets.*

Saturn	—	h
Jupiter	—	u
Mars	—	♂
Sol	—	○
Venus	—	♀
Mercury	—	☿
Luna	—	☽

*The Signs.*

Aries	—	♈	Libra	—	♎
Taurus	—	♉	Scorpio	—	♏
Gemini	—	♊	Sagittarius	—	♐
Cancer	—	♋	Capricorn	—	♑
Leo	—	♌	Aquarius	—	♒
Virgo	—	♍	Pisces	—	♓

*Characters, or Symbols now commonly used by Algebraical Writers.*

= Is the Sign of Equation, and signifies Equal to. As A

= B. Is A. equal to B.

&gt; Is the Sign of Majority, and signifies Greater than, As A &gt; B. Is A greater than B.

Is the Sign of Minority, or Less than, As  $A \angle B$ . Is A Less than B.

+ Is the Sign of Addition, and signifies more, As  $+ A + B$ . Is A more B. yet sometimes the Sign of the first Quantity is left out, As  $A + B = A + B$ , That is more A. more B. Is equal to A more B.

- Is the Sign of Subtraction, and signifies Less, As  $A - B$ . Is A less B

$\times$  Is the Sign of Multiplication, and signifies Multiplied by, As  $A \times B$ . Is A multiplied by B.

The Sign of Division is a Line drawn between two or more Quantities, that stand under one another, As

$A + B \overline{-} C$

which is thus to be read,

D

B more B. less C. Divided by D. or sometimes thus; D )

$A + B \overline{-} C$ . that is, D. is to divide A more B. less C.

:: Is the Sign of continual Proportion, As A, B, C, D, E, :: shows that these Quantities are in Continual Proportion.

:: Is the Sign of Interruption, and denotes the middle of 4 Proportionals interrupted, As  $A. B. :: Y. Z.$  Is thus read, As A. to B. so is Y. to Z.

( ) A Parenthesis, with an Index in it, signifies Involution; As  $A + B. (2)$  Is the square of A less B. or  $A - B. (3)$  is the Cube of A. less B.

/ A Radical Sign with an Index before it, signifies Evolution, as  $\sqrt[2]{A - B}$ . Is the Square Root of A less B. or,  $\sqrt[3]{A - B}$ : Is the Cube Root of A less B. But through a common Custom  $\sqrt[2]$ , is usually taken for a Square Root.

7

## *An Explanation of the Plate of Mathematical Instruments.*

### **A**

**A** Limicant or Staff, made of Peartree or Box with an Arch of 15 deg. to take Observations of the Sun, about the times of its Rising and Setting, Fig. 61. in Order to find the Amplitude, and consequently the Variation of the Compas.

**Astrolabe**, a Circle made in Brass with an Index and Sights, having one Quadrant divided into 90 deg. to take Altitudes. Fig. 1.

**Astronomical Quadrant, Sextant, &c.** Instruments (generally very large) curiously fram'd, and the deg. exactly and minutely divided by the help of a Screw on the Edge of the Limb, fitted with Telescopes on a strong Axis or Pedestal, with 2 Semicircles plac'd at right Angles on 2 endless Screws, which readily direct or guide the Instrument, to take Observations of the Sun, Moon and Stars. See the description in D. Hooke's Tracts. F. 2.

**Azimuth Compasg**, made in a large brass Box, with jambols and a broad limb having 90 degrees diagonally divided, with an Index and Thread to take the Sun's Amplitude or Azimuth, in Order to find the difference between the Magnetical Meridian and the Sun's Meridian, which shews the Variation of the Compas. Fig. 3.

### **B**

**B** Barometer, } An Instrument as defined in the Dictionary, } nary, vide Barometer, and made use of to take the Height of Mountains, Hills, Steeples, &c. and the depth of Caves, Wells, Mines, &c. and to foretel Storms at Sea. Fig. 4.

**Beam Compasses**, an Instrument made in Wood, or Brass, with sliding Sockets to carry several shifting Points

for large Projections, and much used for drawing the Furniture on Wall-Dials.

**Settel**, an Instrument common to Builders, Carpenters, and Bricklayers. Fig. 6.

**Bow**, a Beam of Wood or Brass with 3 long Screws, that Govern or Direct a lath of Wood or Steel, to any Arch: used commonly to draw Draughts of Ships, Projections of the Sphere, or where-ever 'tis requisite to draw large Arches. Fig. 7.

**Bricklayers Rules**, generally made of Box, 2 Foot or 18 Inches long, with a Joint to fold, and Lines properly adapted to measure Brick-Work. Fig. 8.

**C**hains, made for surveying of good hard *Wire*, according to Rathborn, Leyborne, Wing, &c. See Gunter's Chain also.

**Circumferentor**, an Index and Sights of Wood, or Brass, Fig. 9. with Box and Needle, and Ball and Socket, fitted to a 3 legg'd Staff.

**Callipers**, made like a sliding Rule, to embrace the 2 Heads of any Cask, to find the Length. Fig. 10. See Gunter's Callipers. Fig. 26.

**Compasses of Proportion**, to divide Lines and Circles into proportional Parts at one opening of the Compasses, Fig. 28. very much used in reducing, or inlarging of Maps, or Draughts, improved by adding, removing, or shifting Points.

**Cone**, made in Box, and cut into the several Sections, called the *Parabola*, *Hyperbola*, *Ellipsis*, *Triangle* and *Circle*, Fig. 11. the knowledge whereof is useful in drawing the Furniture on Sun-dials, &c.

**Cross-staff**, made of Box or Pear-tree, commonly called a *Fore-staff*, because of taking forward Observations: and may be made also a *Back-staff*, by adding a forth Vein and Sight used by Seamen, to find the Meridian Altitude of the Sun or Stars, in Order to find the Latitude also used in Surveying to take Angles. Fig. 12.

**Cube**,

**C**ube, a regular Solid (one of the 5 Platonick Bodies) contained under 6 Square Planes.

D.

**D**raught Compasses, with several removing Feet to draw fine Draughts of Charts, Maps, &c. Fig. 60.

**D**ividers, are like a pair of Compasses, generally made in Steel, confined by the help of a Screw to be more steady in small Operations; Fig. 14. sometimes a pair of brass Compasses, Fig. 15. (call'd Platts) are used by Seamen, on Charts and Maps, as Dividers.

**Dodecahedron**, a Solid Figure contained under twelve equal Pentagons (one of the 5 Platonick Bodies) Fig. 58. sometimes fitted on a Pedestal with Dials drawn on every Plain.

**D**rawing-Pen, made with a pair of steel Chops, governed by a Screw to draw lines finer or grosser, Fig. 16. also made to draw 5 or 6 lines together for Musick Books.

**D**ials, variously made, but the most ornamental and useful are graduated on large plates of Brass fix'd on Pedestals, Fig. 17. For the Gardens of the Nobility and Gentry, to set, examine, and adjust their Clocks and Watches. These sort of Dials are sometimes small for a Post of a Window.

E.

**E**lliptical Dial, made in Brass or Silver, with a Joint to fold together, and the Gnomons to fall flat-Commodiously contrived to take little room in the Pocket, and is preferable to most other Sun-dials, because it finds the true Meridian Hour of the Day, Rising and Setting of the Sun, and many other Propositions of the Globe, depending wholly on it self. Fig. 18.

**E**lliptical Compasses, made in Brass, to draw at one Revolution of the Index any Ellipsis or Oval. Fig. 19.

Gauging

**G.**

**Gauging Rod**, commonly made with 3 Joints, with a Semicircle to take Diameters: See also the several Sliding Rules, and the Application of them by the several Authors, to the Art of Gauging. Fig. 20. **Wolsten's Rules**, made of 2 Pieces of Box that slide by one another, with lines well contrived for their Work. Fig. 21.

**Globes**, Celestial and Terrestrial in brass Meridians (with a Quadrant of Altitudes,) commonly fitted in Walnut-tree Frames, Fig. 22, 23. being an easie Introduction to Geography and Astronomy; sometimes on a Pedestal only: fitted also in Cases for the Pocket. See use of the Globe.

**Gunter's Quadrant**, made in Wood or Brass, Curiously contrived to find the Hour and Azimuth, and most Propositions of the Globe: Also, the Height of Trees, Sheeples, &c. See a small Tract of its use. Fig. 24.

**Gunter's Chain**, made of hard Wire, being 4 Poles in 100 Links, with brass Distinctions at every 10 Links, of Excellent use in Surveying of Land to the easie and speedy finding the Contents in Acres.

**Gunter's Scale**, made commonly of Box 2 Foot long, with Numbers (called *Gunter's line*) and Sines and Tangents, with Chords, Rhombs, Leagues, Longitude, and equal Parts, Inches and Foot Measure, and a double Diagonal Scale, Particularly useful in Navigation, and likewise in most parts of the Mathematics. Fig. 25.

**Gunter's Rules**, **Quadrants**, **Callipers**, Fig. 26. **Powder-tryals**, **Heights**, **Mouth-pieces**, Fig. 27: strength and Weight of Powder, Weight of Shot, length of Ladle, Elevation of the Piece and many other requisites.

**Half,**

H.

**H**alf and whole Compasse, made of Brass with Steel Joints, used to enlarge or diminish Draughts, or Maps, so that to whatever distance you open the long Points, the other gives you the just half. Fig. 28.

**I**cosahedron, described before, Fig. 29. and also used sometimes on a Pedestal, for variety of Dials on each Plain.

L.

**L**abel, a long thin brass Ruler with a small sight at one end, and a Central-hole at t'other; commonly used with a Tangent Line, on the Edge of a Circumferentor, to take Altitudes. Fig. 30.

**L**evel, (Water) See also a Water-level made of Wood or Brass, with 2 Sights and a Glass, almost fill'd with Spirit of Wine, with a Cover, divided into several equal parts, whereby to adjust the bubble, with a Sprang to fit it to a 3 legg'd Staff, and a long Screw to rectifie the Bubble by the help of a Plummet, that hangs on one of the sights, Fig 3. Sometimes instead of the long Screw, and Sprang they fit a Rack, being 2 Semicircles at right Angles, with a Thread of Worm, upon 2 endless Screws, which with a Key readily brings the Instrument to a true Level; and generally to help the sight they add Telescopes. See Fig. 30. Used by Engineers, Surveyors, and other Artists to find the true Level, for conveying Water to supply Towns, making Rivers Navigable, dredging Fens and Boggs, &c. also for the Builders Level.

**M**agnet, (Iron) See also Classes of Invention. Fig. 31.

Magnet,

## M.

**M**agnet, or Load-stone Armed with 2 Iron sides, that embrace the North and South Poles, which so mighty increases the Virtue or Power, that 'tis much more useful for touching Compasses, Needles, &c. Fig. 33.

**Micrometer**, an Instrument made of Brass, with a Movement and a plate or face divided like a Clock or Watch, with an Index or Hand, which (being turned) moves two sliding Plates of Brass with hairs, and counts on the Plate the Revolutions or Turns of the endless Screw. This Instrument is fitted to a large Telescope, and used in Astronomy to find the Diameters of Stars.

**Miner-dial**, A Box and Needle with a brass Ring, divided into 360 degrees, with several Dials Graduated thereon, generally made for the Use of Miners.

## N.

**Diurnal**, an Instrument made of Box or Ivory, divided on both sides to take the Altitude or Depression of the Pole-star, in respect to the Pole it self, in Order to find the Latitude and nearly the Hour of the Night, Fig. 34. See its Explanation in most Books of Navigation.

## O.

**Orchestrion**, Fig. 35. made use of also on a Pedestal, to draw various sorts of Dials. See the letter O.

**Ongthred's** double Horizontal Dial, made of Brass, with a double Gnomon, one to shew the Hour, on the outward Circle, the other to shew the same Hour in the Stereographic Projection, (drawn on the Plate) This not only finds the Meridian and Hour, but shews the Sun's place, Rising and Setting, Declination, Amplitude, Altitude, and Azimuth, Diurnal Arch and many other useful Propositions, and very well apply'd to the making of Dials. See Mr. Ongthred's Circles of Proportion. Fig. 17.

Parallel

**P.** Parallel Uuler, made in Brass or Wood to draw Lines parallel to each other; of great use in Fortification Architecture and many other parts of the Mathematicks

Fig. 36.

Parallelogram, an Instrument made of 5 Rulers of Brass or Wood, with Sockets to slide or set to any Proportion; used to enlarge or diminish any Map or Draught; used in Fortification, Building and Surveying.

Parallelogram Protractor, a Semicircle of Brass with 4 Rulers, in form of a Parallelogram, made to move to any Angle; one of which Rulers is an Index which shews on the Semicircle the Quantity of any inward or outward Angle.

Perambulator, (or Walking Wheel) made of Wood or Iron; commonly half a Pole in Circumference, with a movement and a face divided, like a Clock with a long Rod of Iron or Steel, that goes from the Center of the Wheel to the Work. There are two Hands which (as you drive the Wheel before you) count the Revolution, and from the Composition of the Movement, and by the divisions on the Face, shew how many Yards, Poles, Furlongs and Miles you go. A very useful Instrument speedily to measure Roads, Rivers and all level Lands: sometimes they are made to answer according to all foreign Measures.

Plain Table, an Instrument commonly made of Walnut-tree, with a box Frame large enough to strain a sheet of paper; one side divided into 360 Degrees, the other side divided into 180 Degrees, with equal parts on each side, (to draw Parallels) to the Table is fitted a Box and Needle with a brass Ring divided into 360 degrees, and the Points of the Compass drawn on a Plate of brass at the bottom, with a brass Sprang to fit a three legg'd Staff, Fig. 97. There are also a brass Index and Sights, not only to cut the degrees on the plain Table, but fitted to the Box and Needle, to serve with a Label as a Circumferentor. Thus fitted it performs as the Theodolite, Semicircle, Circumferentor, &c. See Holwell, Leyborne, and Wing's Surveying.

Plow.

## M.

**M**agnet, or Load-stone Armed with 2 Iron sides, that embrace the North and South Poles, which so mightily increases the Virtue or Power, that 'tis much more useful for touching Compasses, Needles, &c. Fig. 33.

**Micrometer**, an Instrument made of Brass, with a Movement and a plate or face divided like a Clock or Watch, with an Index or Hand, which (being turned) moves two sliding Plates of Brass with hairs, and counts on the Plate the Revolutions or Turns of the endless Screw. This Instrument is fitted to a large Telescope, and used in Astronomy to find the Diameters of Stars.

**Mine-dial**, A Box and Needle with a brass Ring, divided into 360 degrees, with several Dials Graduated thereon, generally made for the Use of Miners.

**N**ournal, an Instrument made of Box or Ivory, divided on both sides to take the Altitude or Depression of the Pole-star, in respect to the Pole it self, in Order to find the Latitude and nearly the Hour of the Night, Fig. 34. See its Explanation in most Books of Navigation.

**O**ctahedron, Fig. 35. made use of also on a Pedestal, to draw various sorts of Dials. See the letter O.

**Oughtred's double Horizontal Dial**, made of Brass, with a double Gnomon, one to shew the Hour, on the outward Circle, the other to shew the same Hour in the Stereographic Projection, (drawn on the Plate) This not only finds the Meridian and Hour, but shews the Sun's place, Rising and Setting, Declination, Amplitude, Altitude, and Azimuth, Diurnal Arch and many other useful Propositions, and very well apply'd to the making of Dials. See Mr. Oughtred's Circles of Proportion. Fig. 17.

Parallel

**P.** *Parallel Ruler, made in Brass or Wood to draw Lines parallel to each other, of great use in Fortification Architecture and many other parts of the Mathematicks Fig. 36.*

**Parallelogram**, an Instrument made of 5 Rulers of Brass or Wood, with Sockets to slide or set to any Proportion, used to enlarge or diminish any Map or Draught; used in Fortification, Building and Surveying.

**Parallelogram Protractor**, a Semicircle of Brass with 4 Rulers, in form of a Parallelogram, made to move to any Angle; one of which Rulers is an Index which shews on the Semicircle the Quantity of any inward or outward Angle.

**Persimulato<sup>r</sup>**, ( or Walking Wheel ) made of Wood or Iron, commonly half a Pole in Circumference, with a movement and a face divided, like a Clock with a long Rod of Iron or Steel, that goes from the Center of the Wheel to the Work. There are two Hands which ( as you drive the Wheel before you ) count the Revolution, and from the Composition of the Movement, and by the divisions on the Face, shew how many Yards, Poles, Furlongs and Miles you go. A very useful Instrument speedily to measure Roads, Rivers and all level Lands: sometimes they are made to answer according to all foreign Measures.

**Plain Table**, an Instrument commonly made of Walnut-tree, with a box Frame large enough to strain a sheet of paper; one side divided into 360 Degrees, the other side divided into 180 Degrees, with equal parts on each side, ( to draw Parallels ) to the Table is fitted a Box and Needle with a brass Ring divided into 360 degrees, and the Points of the Compass drawn on a Plate of brass at the bottom, with a brass Sprang to fit a three legg'd Staff, Fig. 97. There are also a brass Index and Sights, not only to cut the degrees on the plain Table, but fitted to the Box and Needle, to serve with a Label as a Circumferentor. Thus fitted it performs as the Theodolite, Semicircle, Circumferentor, &c. See Holwell, Leybourn, and Wing's Surveying.

**P**lumb, made of Box or Pear-tree; used by Seamen to take the heighth of the Sun or Stars, in order to find the Latitude: it admits of the Degrees to be very large, and is greatly esteemed by many Artists.

**P**rotractor, a thin Semicircle of Brass or Silver, containing 180 Degrees diagonally ( which is accounted the best way ) or otherwise subdivided, figured both ways by 10, 20 to 180, and back again by 190, 200 and so to 360; Fig. 38. some Artists will have 180 Degrees graduated on a Parallelogram or long Square in the Nature of Tangents, and use it to draw Parallel Lines from the opposite degrees and parts; sometimes ( for young Students ) we make a Protractor, a whole Circle containing 360 Degrees. These Instruments are used by Surveyors, Engineers and others, speedily to prouect or lay down any Map or Draught upon Paper, or where-ever it is needful to measure or make any Angle.

**P**rotracting Pin, a taper piece of brass with a Point of Silver, to draw black Lines on Mathematical Paper, and a small Head to screw out and turn in, which holds a fine Needle to prick off any Degree and part from the Protractor. Fig. 39.

**Pyramide**, made sometimes of Box, and cut into 3 Pyramids. Fig. 40.

**Q**adrants, ( as Davis's Quadrant and Sea Quadrant ) made of Box, Pear-tree, or Ivory, composed of two Arches; the lesser Arch containing 60 Degrees, and the large Arch 30, which make a Quadrant ( or 90 Degrees ) diagonally divided into evry minute of a Degree, with 3 Veins or Sights: the great Arch conveniently plac'd for the advantage of light, the lesser for the advantage of the shadow. This Instrument is used by Navigators to take the Meridian Altitude of the Sun, in order to find the Latitude, Fig. 4. sometimes we make the large Arch to contain but 25 Degrees, and the lesser Arch but 65 Degrees, for convenience of Carriage.

*Reducing*

## R.

**R**educing Scale, a thin broad piece of Box with several different Scales of equal Parts, and Lines to turn Chains and Links into Acres and Rods, (by inspection) used by Surveyors, to reduce any Map or Draught, Sometimes 'tis called a Surveying Scale.

## S.

**S**ector, made of Silver, Brass, Ivory, or Wood of all Sizes, and framed with a curious Joint (formerly called a French Joint), much improved in the contrivance and performance; with a piece to turn out to make a true Square, Lines from the Center are Sines, Tangents, Secants, equal Parts, Rhombs, Polygons, Solids, Superficies, Hours, Latitudes, &c. Fig. 42. particularly contrived for Navigation, Surveying, Dialling, Astronomy, Projection of the Sphere, &c. by Gunter, Foster, Collins, and others; likewise for Fortification and Gunnery, (by Sir Jonas Moor) see his description and use. This Instrument, for its numerous Uses and easie Carriage, bears one of the greatest Characters among Mathematical Instruments, and also well applied to practical Mathematicks, by several Foreign Authors.

**H**eliotericum Telescopium, an Horizontal Dial with a Telescope, adapted for observing the Moment of time, by Day or Night, to regulate and adjust Pendulum Clocks, Watches, and other time Keepers. See Molyneux, of the use with a Copper Cut of the Instrument.

**H**eamozzi's Rule, a 2 Foot joint Rule, with Work properly adapted for the Use of Builders: See his Book of Architecture.

**H**emiscope, made of Brass, with an Index and Sights Box and Needle, Ball and Socket, and Staff; containing 180 Degrees, being half the Theodolite: (See Theodolite.)

**S**erle's

**Serle's Scale**, in Wood or Brass, with Lines ingeniously adapted to the Art of Dialling.— See *Serle's Book of Dialling*.

**Sinical Quadrant**, made of Brass or Wood, which by the Sines drawn from each side, intersecting one another with an Index, divided by Sines also, with 90 Degrees on the Limb, and 2 sights on the Edge, to take the Altitude of the Sun. Sometimes ( instead of Sines ) we divide all into equal Parts. Used by Seamen to solve ( by Inspection ) any problem of plain Sailing, and Questions in Astronomy. Fig. 43.

**Gilding Gunter**, made of Box, with a middle piece that slides between 2 pieces, with Lines to answer Proportions by Inspection; chiefly used by Mariners, Fig. 44. See *Gunter's Scale*.

**Sphere**, made of silver or brass Hoops, or Rings, representing the Principal Circles of the Sphere ( called a material Sphere ) Fig. 45. or according to the Systems of *Ptolemy*, Fig. 46. *Ticho Brahe*, Fig. 47. and *Copernicus*, Fig. 48. See a Book of the Use of the Globes.

**Square**, made of Brass or Wood, having one side perpendicular, or at right Angles to the other; sometimes made with a Joint to fold ( for the Pocket ) and sometimes has a back to use on a drawing Board, or anything that has the Edges very strait to guide the Square, Fig. 49.

**Station-staff**, made of 2 Rulers that slide to ten Foot, divided into Feet and Inches; with a moving Vein or sight, two of which are used with a Level, and on the Edges we divide the Links of *Gunter's Chain*: used in Surveying for the more easie taking off Sets. Fig. 50.

**T**en foot Rods: See *Station-staffs*.

**Tetrahedron**: See Fig. 52. fitted on a pedestal for Dia's.

**Theodolite**, a whole Circle made of Brass, containing 360 Degrees, diagonally or otherwise divided, with an Index and sights moving on the Center, and a Box and Needle in the middle having a brass Ring divided into 360 degrees, and the points of the Compass drawn.

drawn on the bottom, with a Ball and Socket, fitted on a staff to take heights and distances. This is approved as an Excellent Instrument for Surveying, some will have Telescopes instead of the sights. Fig. 53.

**Triangular Quadrant**, is a Sector (see Sector) with a loose piece to make it an Equilateral Triangle, and has the Kalendar graduated on it, with the Sun's place, Declination, and many other useful Lines, and has two Quadrants, or 180 degrees on the Edge, and used with a Telescope, or sights to take Observations of the Sun, or Stars, by the help of a Cross piece that has a Sprang to fit it to a Ball and Socket, and Staff, sometimes with an Index and Sights; used for Surveying. Some Artists will have Veins fitted and use it in Navigation. It is an excellent Instrument, ingeniously contrived to be very portable, and of great use in the Art of Dialling, Fig. 42. See Brown's Book of the use.

**Triangular Compasses**, containing 3 Legs or Feet, to take off at once any Triangle; used on Maps, Globes, &c.

**Three Legg'd Staff**, made with Joints to shut together, and take off in the middle for the better carriage; to support Instruments for Astronomy, Surveying, &c.

## U.

**Universal Equinoctial Dial**, made of 2 Rings of Brass or Silver, that open and fold together with a Bridge or Axis, and a slider, with little Rings to hang or hold it by, divided on one side of the great Ring into 90 Degrees, and 2 Quadrants, or 180 Degrees on the other, and 24 Hours subdivided on the face and inside of the lesser Ring: the Axis has the Sun's Declination and Kalendar, according to the Old and New stile; this Dial finds the Latitude and Hour of the day and most propositions on the Globe. Fig. 54.

N

May.

W.

**W**aywiser, for the Pocket; a Movement, like a Watch to number or count your Steps or Paces, in Order to find how far you walk in a Day.

**Waywiser**, for Chariots; to shew how far your Coach goes in a Day: of the same Nature as the Perambulator only fitted to the great Wheel.

**Waterpoise**, to try the strength of Liquors, Fig. 56. See Dr. Hooke's Tracts.

**Watch-glass**, being 4 Hours; used at Sea, to shift or change their Watches (Fig. 57.) they also use half Watches, Hour-glass, Minute and half Minute-glasses, to count the knots when they heave the Log in Order to find the Ship's way.



**F I N I S.**

VI